THIRD STREET NORTHWEST TRAFFIC & SAFETY STUDY

GREAT FALLS, MONTANA

NOVEMBER, 1980

Robert Peccia & Associates

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November 20, 1980

James W. Hahn, Chief
Planning and Research Bureau
Montana Department of Highways
2701 Prospect Avenue
Helena, Montana 59620

Dear Mr. Hahn:

Transmitted with this letter are 100 copies of the final report for the Third Street Northwest Traffic and Safety Study for Great Falls, Montana as required by our contract agreement.

This report contains information on the traffic and safety investigations that were done, identification of problem areas, and recommendations for improvements. This final report incorporates revisions and additions that were made pursuant to comments that were received on the draft report. The specific comments received and the Consultant's responses were reviewed with the Department of Highways Planning and Research Bureau prior to inclusion. Technical background information and other supporting documentation is contained in the appendices, and in computation reports on file with the Department of Highways.

We have approached this project in a logical and objective manner, and we believe our recommendations are applicable and realistic. We have tried to keep our recommendations within physical, financial, and legal limitations, and feel that implementation of these improvements will improve the operating characteristics of the street.

The Great Falls Transportation Technical Advisory Committee has provided us with excellent technical guidance and support, and we would like to express our thanks to them. We are also grateful for the opportunity to provide these services to the Montana Department of Highways and Great Falls, and appreciate the opportunity to work with them.

Yours very truly,

Robert J. Peccia

Robert J. Peccia, President

Douglas E. Widmayer

Douglas Widmayer, Project Engineer

RJP/gp

GREAT FALLS, MONTANA

THIRD STREET NORTHWEST

TRAFFIC AND SAFETY STUDY

FOR THE

MONTANA DEPARTMENT OF HIGHWAYS

PLANNING AND RESEARCH BUREAU

In cooperation with the
Department of Transportation
Federal Highway Administration

By:
ROBERT PECCIA & ASSOCIATES
HELENA, MONTANA
November, 1980

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INTRODUCTION AND PROJECT SCOPE

CHAPTER I

INTRODUCTION AND PROJECT SCOPE

A. AUTHORIZATION

The Third Street NW Traffic and Safety Study is a cooperative effort of the Montana Department of Highways, the Great Falls City-County Planning Board, the City of Great Falls, Cascade County, and the Federal Highway Administration. The project was initiated at the local level and approved by the state and federal governments. As the funding agency, the Montana Department of Highways has primary responsibility for the completion of the study.

To assist in conducting the study, the Department of Highways retained the consulting engineering firm of Robert Peccia and Associates. A technical proposal outlining a method of approach and the work elements to be done was submitted by this firm to the Department of Highways and the Great Falls Transportation Technical Advisory Committee for review and approval. A contract to conduct the project was awarded to this firm in March of 1979.

This project was funded through the use of Federal Aid Urban funds allocated to the Great Falls urbanized area.

B. PURPOSE OF PROJECT

Substantial development has occured along the Third Street NW corridor the past several years, and local officials have voiced concern about the continuing ability of the street to provide a high level of transportation service. In particular, the activity in commercial development which is often attracted to high-traffic areas has been increasing. As this type of development occurs, encroachments onto the smooth flow of traffic are made by driveway accesses and increased locally-destined traffic as opposed to through traffic. This situation results in greater traffic conflicts, interrupted flow, increased accident rates, and decreased ability of the street to handle traffic. In order to provide for the transportation needs of the additional development which has shown an interest in the corridor, foresight and planning are essential.

This study addresses the existing problems which are occuring in the corridor, and provides recommendations for future improvements that will minimize the effect of adjacent development on the traffic characteristics of Third Street NW. The specific purposes of the project are as follows:

(1) Identify the existing and future needs of the corridor

(2) Analyze the traffic flow and safety characteristics of the corridor

(3) Provide a coordinated plan of improvements that will improve the efficiency and safety of the corridor.

C. DESCRIPTION OF PROJECT AND STUDY CORRIDOR

Third Street NW is a federal aid urban street (FAU 5203) located in the northwest section of

Great Falls. The project corridor provides a vital link in the arterial street system of Great Falls connecting the arterials of Central Avenue to Tenth Street North. The arterial studied extends from the intersection of Third Street NW and Central Avenue West northerly along Third Street NW to its intersection with Smelter Avenue, then easterly along Smelter Avenue to the intersection of Smelter Avenue and Tenth Street North (see Figure No. 1). The street is the primary facility for vehicular travel between the western and northern areas of Great Falls. Residential development to the north and commercial development along the corridor have increased the importance of the local access function of the corridor.

Recent major improvements to Third Street NW include widening to a four-lane street with a median and curb and gutter in 1969, and a section of street lighting that was installed in 1970. The street is in generally good physical condition, and has been performing its function well.

The scope of this project included collecting information on the physical and operational characteristics of the corridor, analyzing the existing and potential problems, and identifying appropriate improvements to relieve these problems. The physical characteristics investigated included geometrics, traffic signals, street lighting, traffic access facilities, and traffic striping and signing. Operational characteristics were identified through the use of traffic studies including traffic volume counts, intersection turning movement counts, traffic conflict studies, accident studies, pedestrian and bicycle studies and an off-street parking and circulation study.

The methods and procedures used for these investigations are described in the appropriate sections of this report. The Improvement Plan which is the result of these investigations is contained in Chapter X along with cost estimates and the cost-effectiveness of each proposed improvement.

D. ORGANIZATION

This project is on a Federal Aid Urban Route; however, it is under the maintenance jurisdiction of the Montana Department of Highways. The Department of Highways contracted the study to the consulting firm of Robert Peccia and Associates. Federal funds administered by the U.S. Department of Transportation - Federal Highway Administration are involved in the study, and the Federal Highway Administration also monitors the study.

The Consultant presented progress reports and findings to the Great Falls Technical Advisory Committee which is comprised of members from the City of Great Falls, Cascade County, City - County Planning Board, Montana Department of Highways, Federal Highway Administration, Malmstrom Air Force Base, railroads, and citizen members.

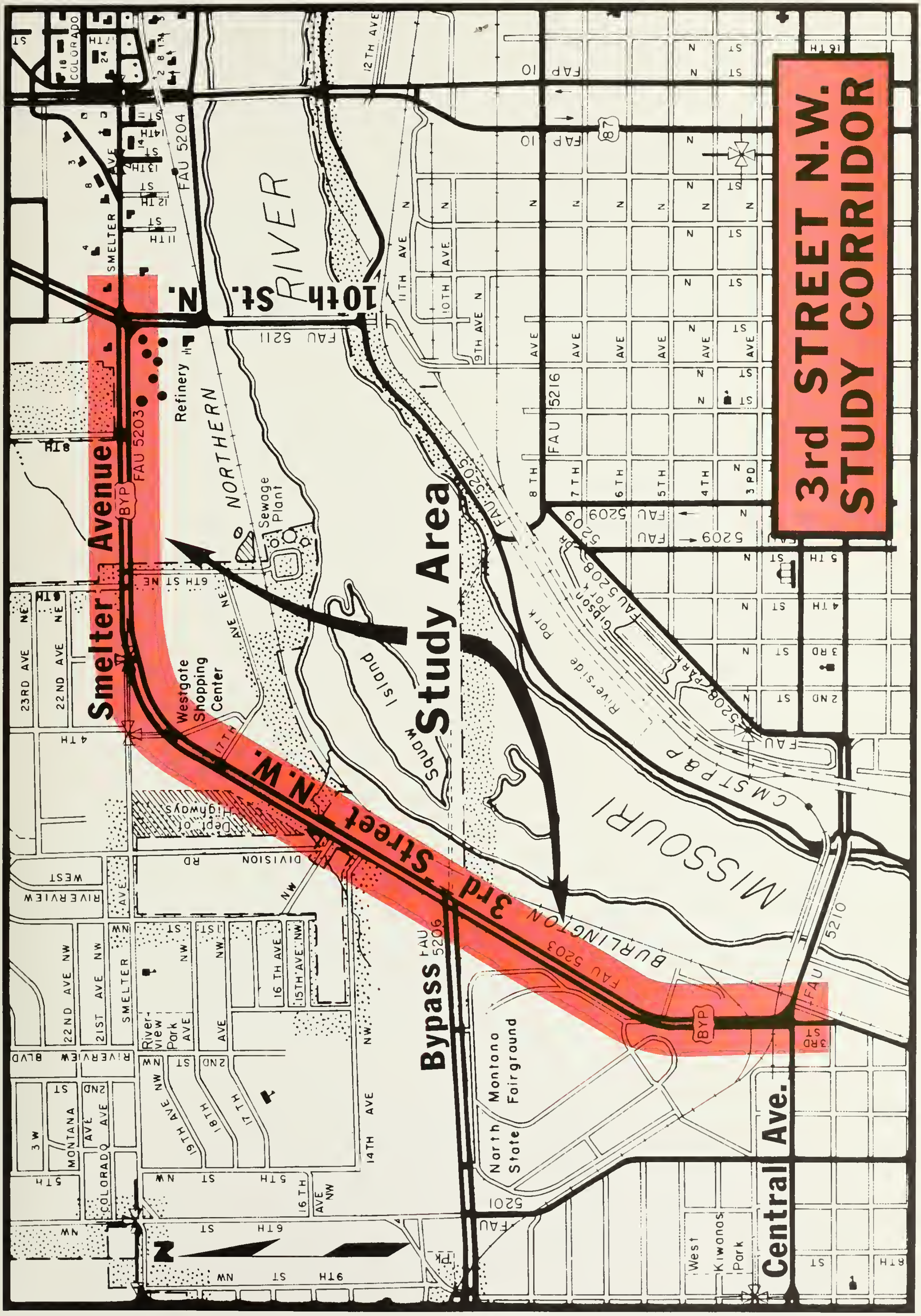

3rd STREET N.W.
STUDY CORRIDOR
Study Area
Smelter Avenue
10th St. N.
3rd Street N.W.
Central Ave.
Bypass
MISSOURI
RIVER
NORTHERN
Refinery
Sewage Plant
Westgate Shopping Center
Dept. of Highways
Montana Fairground
North State
West Kiwanis Park
Gibson Park
Riverside Park
Sand Island
BURLINGTON
CMSTP&P
FAU 5203
FAU 5204
FAU 5211
FAU 5205
FAU 5206
FAU 5216
FAU 5209
FAU 5208
FAU 5210
FAU 5201
FAP 10
DIVISION RD
RIVERVIEW BLVD

FIGURE NO. 1

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. Summary
B. Conclusions and Recommendations

CHAPTER II

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

This report contains the documentation for the methods and procedures used for the analyses conducted, the results of these studies, the problems identified, and recommendations for improvements. The approach used was to first identify problems that are evident on the existing facility, and then anticipate what problems might occur under future conditions.

Experience with high traffic volume corridors in the past has proven that decisions on access policies and other improvements must be made at a stage in the development of an area when restrictions are still practical. It is virtually impossible to alter certain operating characteristics of a street after the investment in adjacent developments has already been made. In the case of Third Street NW, the street is at the stage of evolution such that some parts of the street have adjacent development where certain improvements are impractical, but other areas are virtually undeveloped and access restrictions and other simple improvements are practical. The limitations on the practicality of implementing certain types of improvements have been recognized and reflected in the Improvement Plan, and only those improvements that are considered feasible have been recommended.

Third Street NW was constructed to a high-grade four-lane facility in 1969 with a pavement surface of about seven inches of asphalt over 16 inches of gravel base. Since the design is generally for a 20-year period, the facility has reached only about half of its useful life. This study recognized that the street is in very good physical condition, and the intent was to concentrate on the operating characteristics. Therefore, most of the improvements that have been recommended are oriented to traffic type and spot improvements to traffic flow and safety, rather than major construction improvements.

B. CONCLUSIONS AND RECOMMENDATIONS

The results of the investigations conducted revealed that Third Street NW has very few glaring problems at the present time. Traffic flows at a reasonably even speed, delays are not excessive, accident rates are comparable to similar facilities, and major traffic conflicts are not evident. However, there are improvements that can be made to the street that will significantly improve the current operating characteristics, and that will help to preserve smooth traffic flow along the corridor. These improvements include an extension to the existing street lighting system, improved intersection lighting, better traffic channelization by improving the medians, signing, striping, and turning lanes, reduction in traffic conflicts by modifications to the access, improved pedestrian facilities, and traffic signal system improvements. These investments are cost-effective, are not capital-intensive, and will result in a smoother flowing street for both present and future traffic.

Detailed descriptions of the recommended improvements, cost estimates, and the cost-effectiveness of each improvement is contained in Chapter X of this report.

TRAFFIC STUDIES

A. Traffic Counts
B. Turning Movement Counts
C. Travel Time and Delay Study
D. Intersection Delay Study
E. Accident Studies
F. Traffic Conflicts Study
G. Pedestrian and Bicyclist Study
H. Off-Street Circulation and Parking Study

CHAPTER III

TRAFFIC STUDIES

A. TRAFFIC COUNTS

(1) Annual Variations in Traffic Volumes

The Montana Department of Highways has a comprehensive traffic counting program that provides valuable information on traffic volumes on most major streets in the state. On Third Street NW the Department of Highways has conducted traffic volume counts with portable machine counters for a number of years. These counts, generally two- to three-day counts, are converted into annual average daily traffic volumes by using appropriate seasonal adjustment factors.

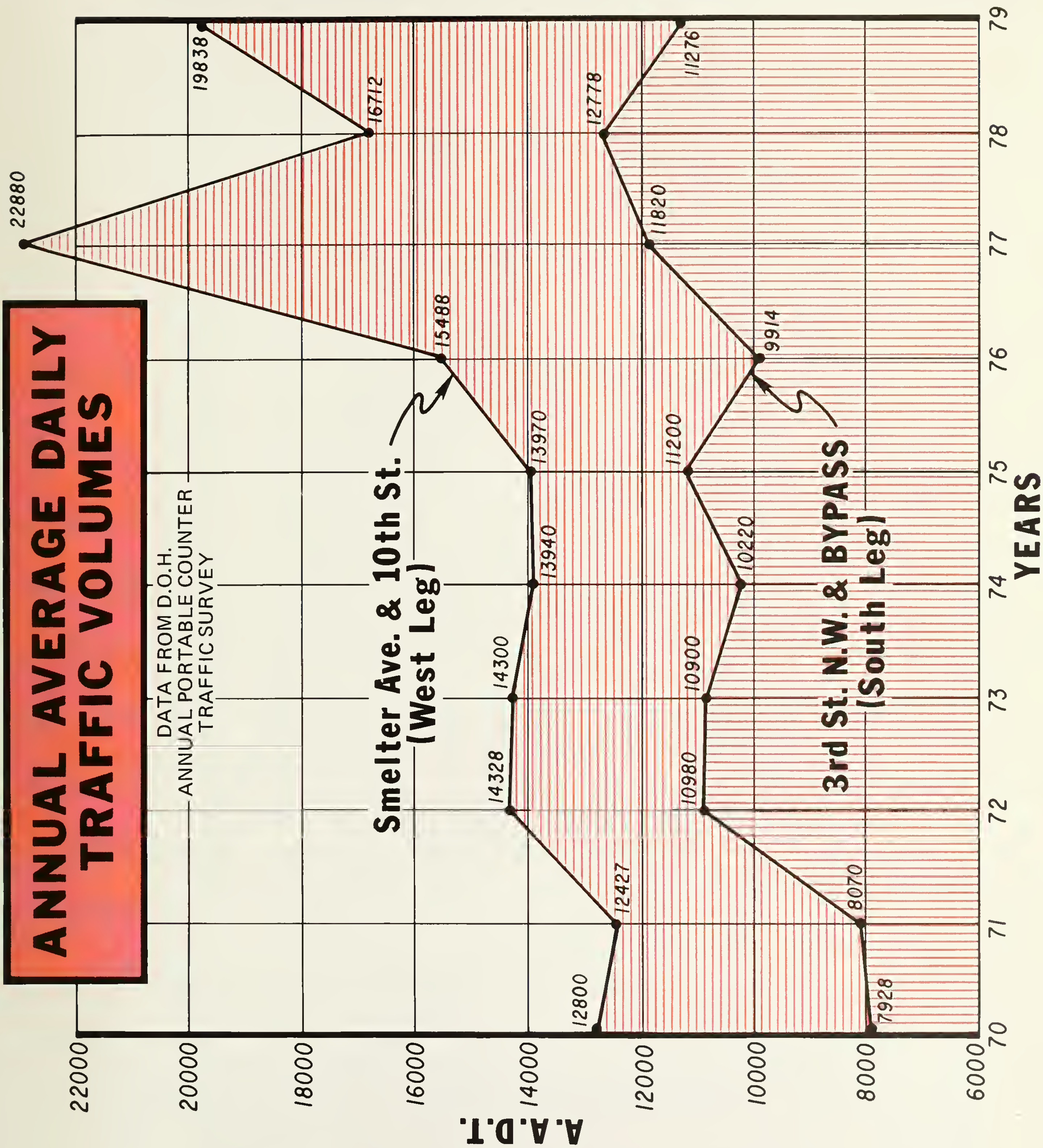
The historical annual average daily traffic volumes for the past ten years for two locations on Third Street NW are shown in Figure No. 2. These two locations chosen are representative of the two sections of the corridor that show substantial traffic volume differences. The section of Third Street NW from Central Avenue to the Northwest Bypass has an average traffic volume of about 11,000 vehicles per day. From the Northwest Bypass to the Tenth and Smelter Avenue intersection, the average traffic volume is about 19,000 vehicles per day. The historical traffic volumes for these two sections are reflected by traffic counts on the south leg of the Third and Bypass intersection, and the west leg of the Tenth Street and Smelter Avenue intersection.

As shown in Figure No. 2, the Smelter Avenue and Tenth Street traffic counts show a wide variation in traffic volumes, and a faster rate of traffic volume increase than the Central to Bypass section. This is likely due to the increased use of the Northwest Bypass in lieu of Central Avenue as an access route onto Third Street NW. Caution should be used in interpreting these results, however, since the traffic volumes are obtained by extrapolating two- or three-day counts, and wide variations in volumes may be due to the procedures used instead of actual volume changes. The construction activity on the First Avenue North Bridge occuring in 1979 and 1980 would also be expected to have a significant impact on the traffic volumes on the Central Avenue end of the corridor. This disruption is probably the cause of the traffic volume decrease on the Central Avenue end of the corridor while the Tenth Street end showed an increase in traffic.

(2) Monthly Variations in Traffic Volumes

In an effort to accurately assess the monthly variation in traffic volume, data from two Department of Highways permanent traffic counts were used. Counter A-33, located on Tenth Avenue South, reflects the traffic characteristics associated with an urban primary route, while Counter A-32, located on Twenty-fifth Street, shows the traffic characteristics experienced on a city arterial. The average daily traffic for each month of the year at these locations is shown in Figure No. 3.

The Third Street NW corridor functions as both an urban primary throughfare and as a city arterial. For the purpose of determining appropriate monthly factors, the information from the two



ANNUAL AVERAGE DAILY TRAFFIC VOLUMES
DATA FROM D.O.H. ANNUAL PORTABLE COUNTER TRAFFIC SURVEY
Smelter Ave. & 10th St. (West Leg)
3rd St. N.W. & BYPASS (South Leg)
A.A.D.T.
YEARS
22000
20000
18000
16000
14000
12000
10000
8000
6000
70
71
72
73
74
75
76
77
78
79
12800
12427
14328
14300
13940
13970
15488
22880
16712
19838
7928
8070
10980
10900
10220
11200
9914
11820
12778
11276

FIGURE NO. 2

MONTHLY VARIATIONS IN A.D.T.
(Great Falls Area)

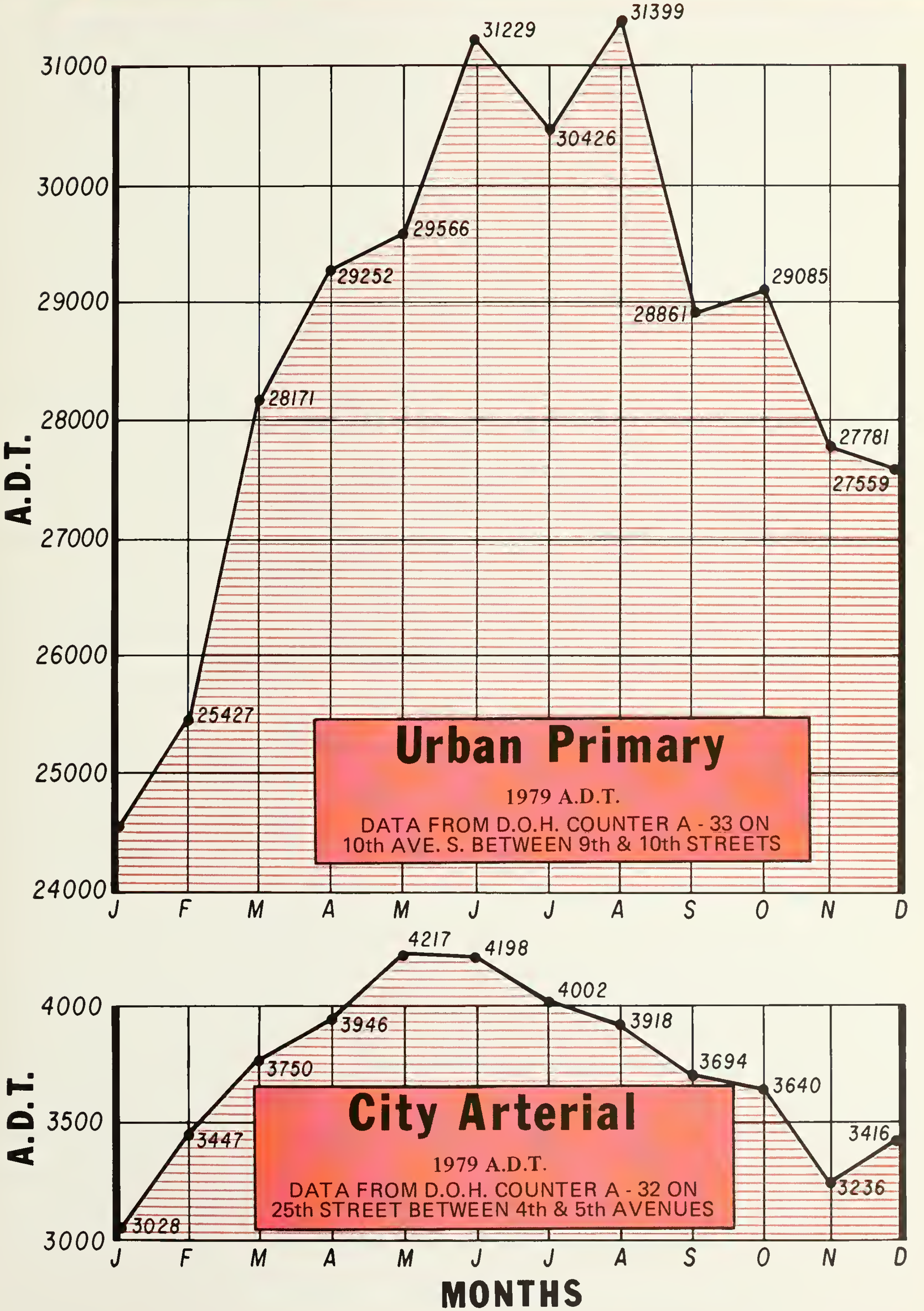


FIGURE NO. 3

permanent counter locations was combined into composite monthly factors. These composite monthly factors are considered to be reflective of the traffic characteristics of Third Street NW.

(3) Hourly Variations in Traffic Volumes

Hourly traffic volume variations for the traffic counter locations at Third Street NW and the Northwest Bypass, and Smelter Avenue and Tenth Street were obtained from the Department of Highways portable traffic counter survey records. Figure No. 4 shows these hourly volume variations for November, 15, 1979.

This figure shows a classic variation of traffic throughout the day with well-defined peak periods occuring at 8:00 a.m., 1:00 p.m., and 5:00 p.m. The maximum peak period occurs in the afternoon at 5:00 p.m., with a peak hour to daily volume ratio of 9.6 percent at Smelter Avenue and Tenth, and 8.8 percent at Third Street NW and the Northwest Bypass.

B. INTERSECTION TURNING MOVEMENT COUNTS

(1) Intersection Counting Procedures

Manual intersection turning movement counts were taken at nine major intersections along the study corridor. The counts were taken by two persons using traffic counter boards and recording turning movement volumes in fifteen-minute increments. Each intersection was counted for two hours during the three peak periods of the same day. From reviewing the permanent traffic counter data for the Great Falls area, it was determined that the Monday through Thursday traffic volumes were relatively consistent, and therefore all traffic counts for this report were performed on these four weekdays to provide uniformity of data.

(2) Results of Turning Movement Counts

The maximum peak hour always occured during the afternoon peak, with the most frequent peak being between 4:30 and 5:30 p.m. A graphic representation of the maximum peak hour turning movements for each intersection is contained in Appendix A.

(3) Conclusions of Turning Movement Counts

The Third and Central intersection has high volumes on the east and west approaches. The east approach has a right-turn ramp to accomodate westbound traffic turning onto Third Street NW. The south approach is signed one-way northbound and has relatively light volumes. The north approach consists of two left-turn lanes and two right-turn lanes which appear to handle the turning movements adequately. It was observed that a substantial backup occurs during all peak periods. This backup can be directly attributed to the First Avenue North Bridge construction project, and is expected to be alleviated at the completion of the bridge improvements.

It was noted that the intersections along Third Street NW at Fourth Street and Smelter

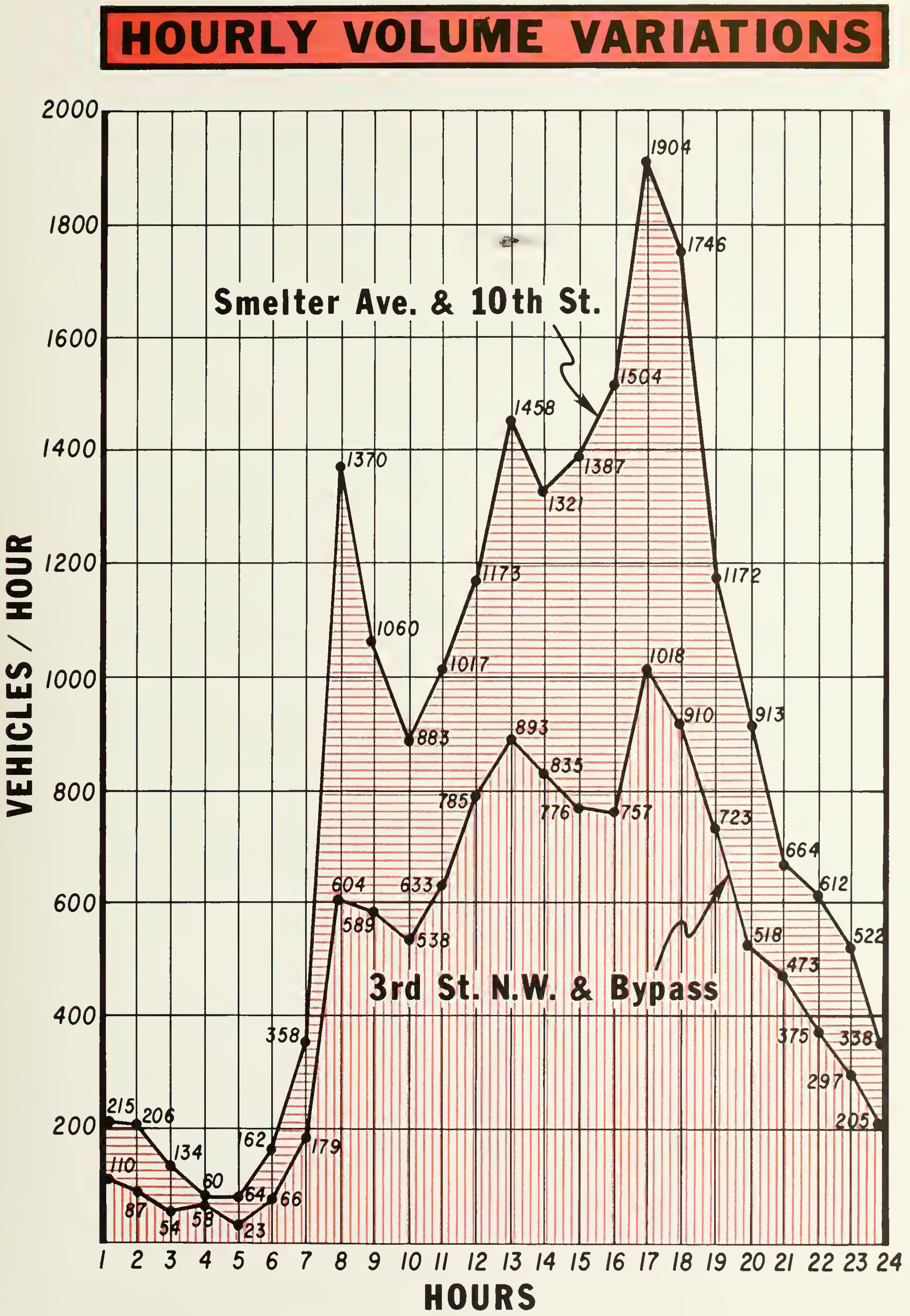

HOURLY VOLUME VARIATIONS
VEHICLES / HOUR
HOURS
Smelter Ave. & 10th St.
3rd St. N.W. & Bypass
2000
1800
1600
1400
1200
1000
800
600
400
200
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
215 206 134 60 64 162 358 1370 1060 883 1017 1173 1458 1321 1387 1504 1904 1746 1172 913 664 612 522 338
110 87 54 58 23 66 179 604 589 538 633 785 893 835 776 757 1018 910 723 518 473 375 297 205

FIGURE NO. 4

Avenue are the major access points serving residential areas in the northwest portion of Great Falls. The large turning movement volumes at these intersections reflect this function of these intersections.

The intersection at Tenth and Smelter is somewhat of a unique situation in that the large majority of the approach traffic performs a turning movement at this intersection. A right-turn ramp is provided for traffic approaching from the west and turning south and two parallel left-turn lanes are provided for the traffic approaching from the south and turning west. In spite of the fact that the intersection has these additional turning facilities, backups still occur during peak periods.

It was also noted that the Smelter Avenue portion of the corridor experiences a directional factor in the traffic flow. During the morning peak period, the majority of the traffic is eastbound, the noon peak is balanced, and the evening peak has a predominantly westbound flow.

(4) Traffic Volume Variations Along the Study Corridor

The turning movement counts also provide a method to show the volume variations along the study corridor by factoring the peak hour volume data to reflect the annual average daily traffic volumes. Figure No. 5 shows the two-way volumes for each leg of the intersections counted. It should be noted that these traffic volumes are subject to fluctuations due to daily variations in traffic volumes, and the interpretation must be done with these limitations in mind.

The interesting features presented in this graph are: 1) the distinct difference in overall traffic volumes between the Smelter portion of the corridor and the other sections of the route. The low volume of traffic between Central and the Bypass (760 veh/hr) is the result of the bottleneck created at Third and Central because of the bridge construction project. Historical data indicates a peak hour volume of 1,000 vehicles under normal conditions for this section of roadway. 2) the major traffic volume drop across the intersections at Third and Central and Tenth and Smelter. These volume drops reflect turning movements off of the corridor onto Central Avenue and Tenth Street. 3) the low traffic volumes between the intersections of Third and Fourth and Third and Smelter. This decrease in volume indicates the effect of the northwestern residential area as an origin and/or destination point.

C. TRAVEL TIME AND DELAY STUDY

(1) Study Procedures

The method used for this test was the *test car technique*, whereby the test car travels the study corridor at a speed matching that of the other vehicles in the flow of traffic. Several test runs are made in each direction during both peak and off-peak periods. Travel times are recorded using a stopwatch to note the overall elapsed time as the test car passes specific checkpoints. Delays are also recorded whenever the test car is stopped or significantly impeded by traffic.

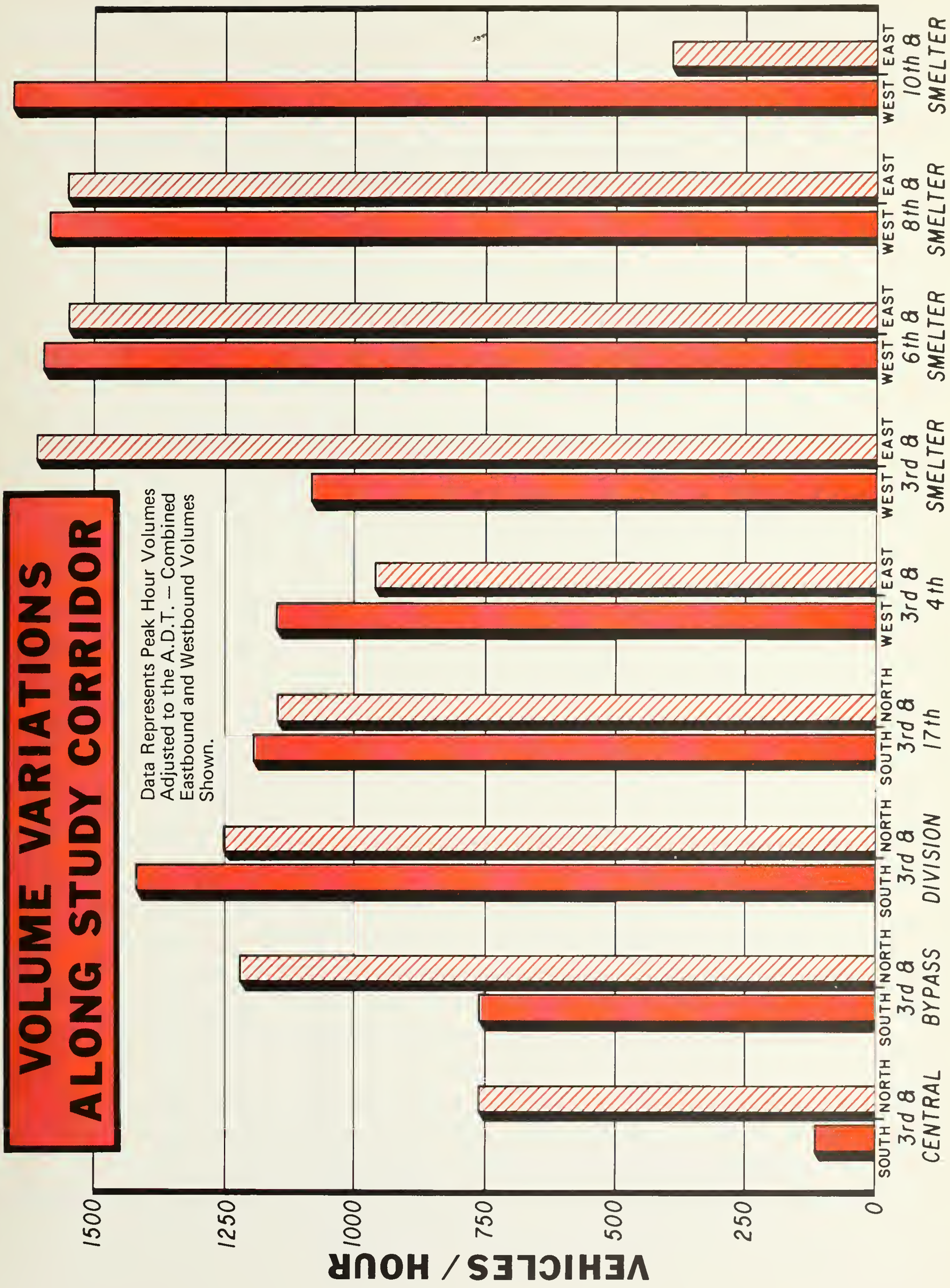

VOLUME VARIATIONS ALONG STUDY CORRIDOR
Data Represents Peak Hour Volumes Adjusted to the A.D.T. — Combined Eastbound and Westbound Volumes Shown.
VEHICLES / HOUR
0
250
500
750
1000
1250
1500
SOUTH NORTH
3rd & CENTRAL
SOUTH NORTH
3rd & BYPASS
SOUTH NORTH
3rd & DIVISION
SOUTH NORTH
3rd & 17th
WEST EAST
3rd & 4th
WEST EAST
3rd & SMELTER
WEST EAST
6th & SMELTER
WEST EAST
8th & SMELTER
WEST EAST
10th & SMELTER

FIGURE NO. 5

(2) **Results of Travel and Delay Study**

Thirty-two trips were made through the Study Corridor, ten trips in each direction during the peak periods and six trips in each direction during the off-peak periods.

The actual travel speeds and running speeds were calculated using the following formula:

Travel Time (sec) – Delays (sec) = Running Time (sec)

Distance (ft) ÷ Travel Time (sec) = Travel Speed (feet/sec)

Distance (ft) ÷ Running Time (sec) = Running Speed (feet/sec)

The overall length of the Study Corridor is 10,475 feet. The speeds arrived at through the preceding formula were converted into miles per hour and are tabulated below. Also shown are the average speeds for both directions during peak and off-peak periods.

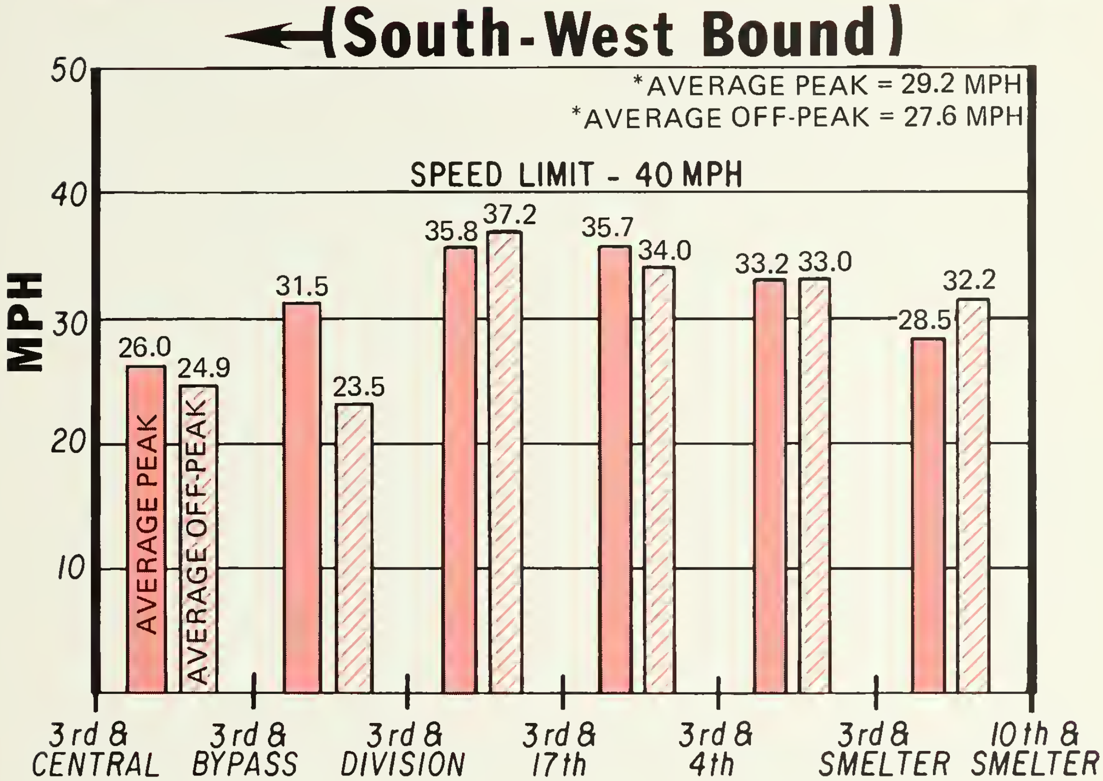
Direction of Travel	Average Travel Speeds (mph)	Average Delays (sec)	Average Running Speeds (mph)
Northeast			
Peak	32.8	15.2	35.3
Off-Peak	31.4	24	35.1
Southwest			
Peak	29.2	33	33.8
Off-Peak	27.6	42.4	33.1

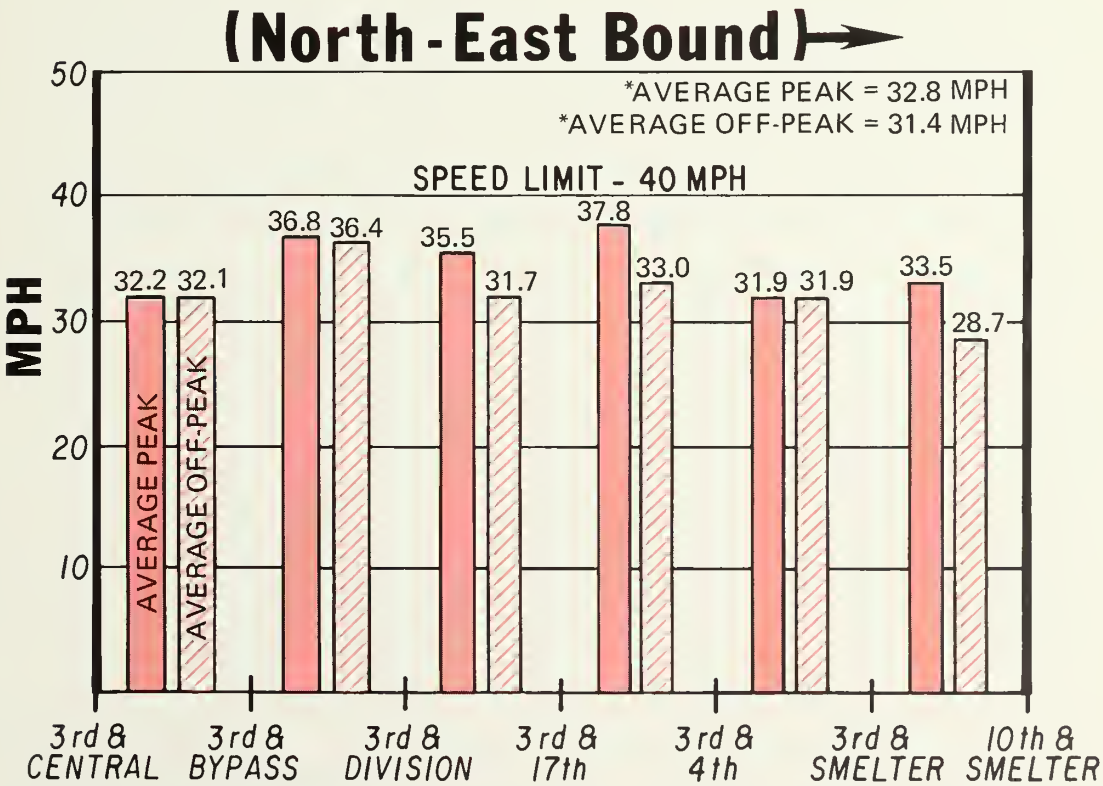
A more detailed breakdown of the travel speeds, running speeds and delays is presented in Appendix B.

It can be noted from Figure No. 6 that the average peak period travel speeds are higher than the average off-peak travel speeds. This situation is very likely caused because (1) the peak period driver is more aggressive than the off-peak because he is more destination-oriented and tends to drive faster; and (2) the traffic volumes on Third Street NW during peak periods maximize the green time given to this street with less delay and more platooning effect, resulting in more efficient traffic flow.

Figure No. 6 shows the average peak period and off-peak period travel speeds. The data reveals that the street functions smoothly at reasonably high and uniform travel speeds with only minor delays during both peak and off-peak periods. The greatest delays occur at both ends of the corridor at Tenth and Smelter and Third and Central, which is to be expected because of the intersections with other high-volume streets and the turning movements required.

AVERAGE TRAVEL SPEEDS





* Average Travel Speed for Entire Length of Corridor

FIGURE NO. 6

D. INTERSECTION DELAY STUDY

(1) Study Purpose and Procedures

Intersection delay studies are conducted to evaluate the efficiency of traffic control systems at signalized intersections. The results of these studies aid in the determination of the proper signal timing sequence, as well as the effectiveness of the intersection geometrics.

The intersection delay study was performed during the peak periods of congestion which are the periods of greatest traffic volume. The standard method used in this particular study involves the counting of vehicles stopped in the intersection approach at successive fifteen-second intervals. A vehicle is counted more than once if it is stopped during more than one sampling interval. The approach volumes are also recorded and classified as either stopped or not stopping to provide the number of approach vehicles that are required to stop.

(2) Intersection Delay Results

The study data has been compiled and presented in Figure No. 7. Three important statistics are summarized in the graph: (1) the percentage of vehicles that are required to stop at the particular intersection approach; (2) the average delay per stopped vehicle in seconds; and (3) the average delay for approach volume traffic in seconds.

(3) Interpretation of Study Results

At the Third and Central intersection, priority is given to the east-west flow along the Central Avenue corridor. The percentage of vehicles stopped and the corresponding delays are somewhat large for all approach directions. This is partially attributable to the congestion caused by the bridge construction as well as the higher traffic volumes found at this intersection. Note that the least delay is incurred by the east approach vehicles, which reflects the relief provided by the right-turn ramp and the reduced traffic volumes on this approach due to the bridge construction.

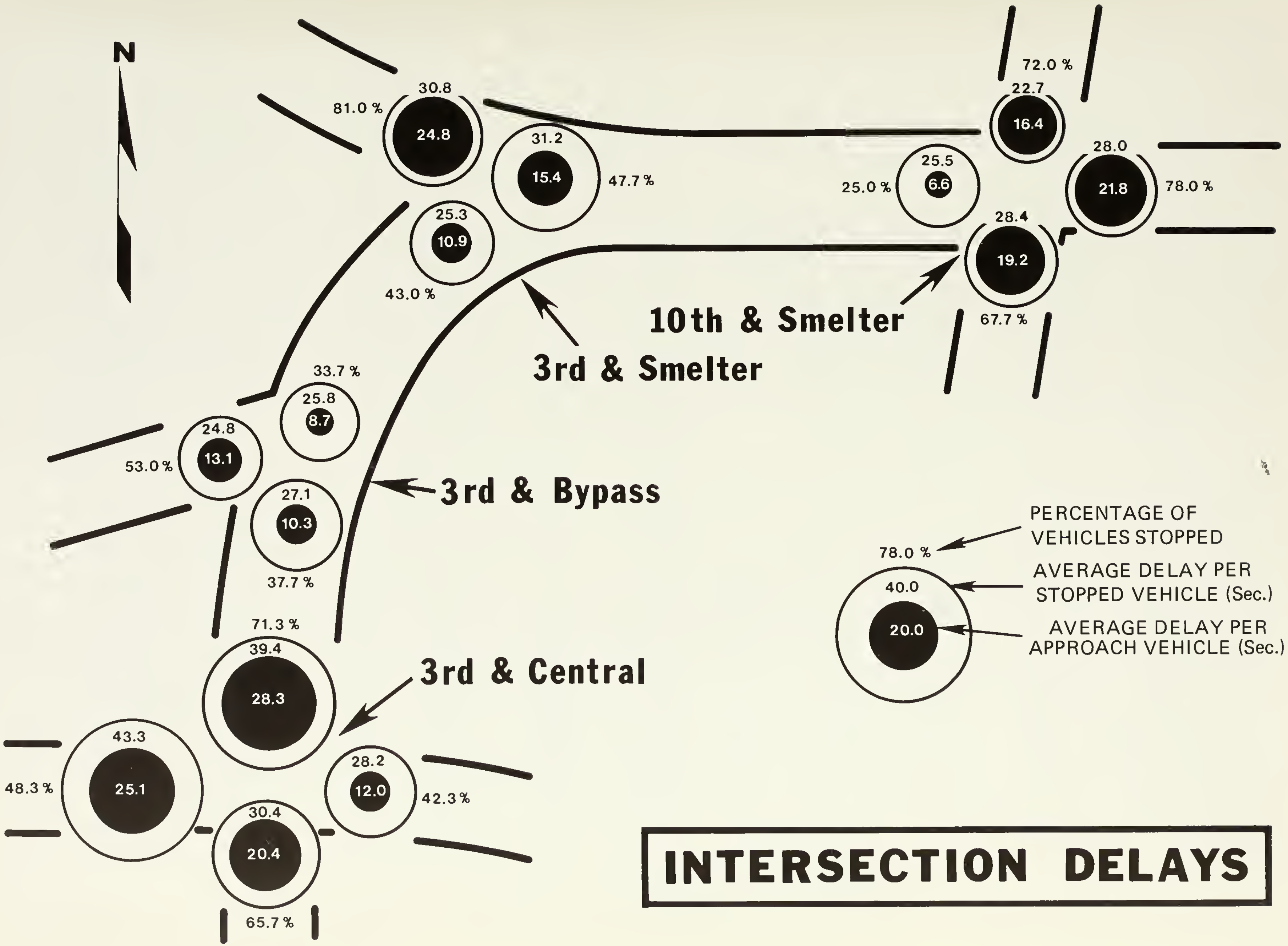
The intersections at Third and Bypass and Third and Smelter function well. Both give priority to the flow along the Third Street NW corridor, with only minimal delays incurred. It should be noted that the high percentage of stopped vehicles on the northwest approach (on Smelter) to the Third and Smelter intersection reflects the use of a trip-actuated signal for this approach.

The Tenth and Smelter intersection is a high-volume intersection with the predominant traffic flow from the south to the west and vice-versa. For the west approach, the existence of a right-turn ramp substantially reduces the percentage of vehicles stopped as well as delay times. However, the south approach still experiences a large percentage of vehicles stopped. The low-volume approaches (north and east) are subject to greater than average percentages of stopped vehicles due to the priority given to the south and west legs of the intersection.

E. ACCIDENT STUDIES

(1) Accident Studies Conducted

All accidents occuring within the study area for the last three years were analyzed. Police



INTERSECTION DELAYS
N
10th & Smelter
3rd & Smelter
3rd & Bypass
3rd & Central
PERCENTAGE OF VEHICLES STOPPED
AVERAGE DELAY PER STOPPED VEHICLE (Sec.)
AVERAGE DELAY PER APPROACH VEHICLE (Sec.)
78.0 %
40.0
20.0
72.0 %
22.7
16.4
28.0
21.8
78.0 %
25.5
6.6
25.0 %
28.4
19.2
67.7 %
30.8
24.8
81.0 %
31.2
15.4
47.7 %
25.3
10.9
43.0 %
33.7 %
25.8
8.7
24.8
13.1
53.0 %
27.1
10.3
37.7 %
71.3 %
39.4
28.3
43.3
25.1
48.3 %
28.2
12.0
42.3 %
30.4
20.4
65.7 %

FIGURE NO. 7

accident reports and collision diagrams were obtained from the Great Falls Police Department and the Montana Highway Patrol. The information was compiled and tabulated according to location, time of day, type of accident, and severity. The actual reports and diagrams are contained in a computation report on file at the Department of Highways, Planning and Research Bureau in Helena.

(2) Summary of Accident Data

The accidents that occured from June, 1977 through May, 1980 are listed by type as follows:

Accident Type	Number
Property Damage	246
Personal Injury	51
Bicyclist Injury	2
Pedestrian Injury	0
Fatality	0
Total:	299

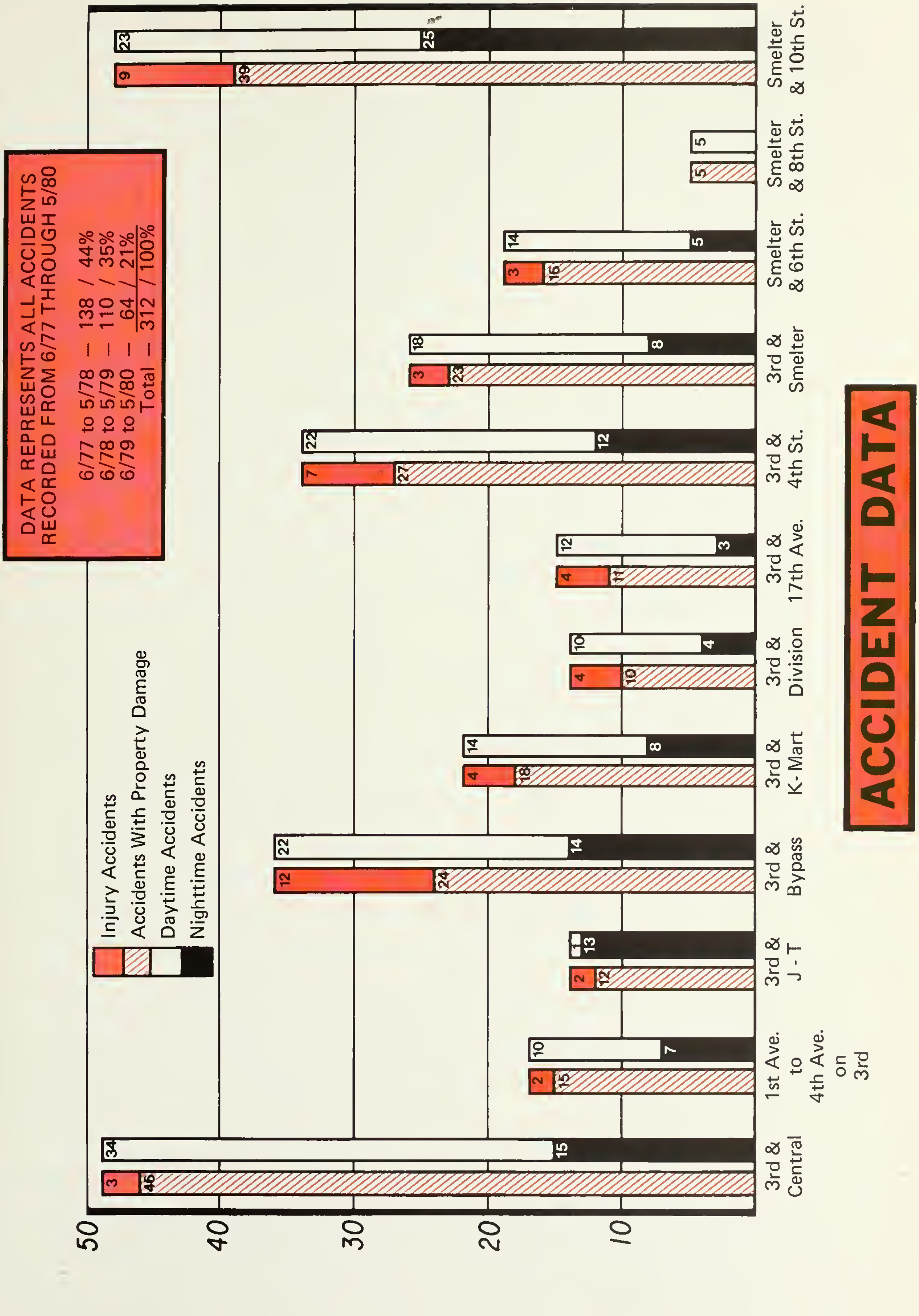
Figure No. 8 presents the three-year accident totals by type and location. These accidents are further broken down into daytime and nighttime totals. No fatal accidents occured within the study area during this period.

The corridor was divided into three sections for ease of analysis, each slightly less than three-fourths of a mile in length. The accident rates for each section were computed and are shown in Table No. 1.

Individual intersection accident rates were also calculated according to the method described in the Institute of Transportation Engineers' *Manual of Traffic Engineering Studies*. The intersection accident rates represent the number of accidents occuring per million vehicles entering the intersection. Daytime and nighttime accident rates were also calculated. This information is displayed in Table No. 2.

(3) Interpretation of Study Results

An inspection of Figure No. 8 shows an annual decrease in accidents for the three years of accidents investigated. Since no physical or operational changes occured during this period, it is suspected that the reduction in accidents is a result of variations in winter driving conditions. The winter of 1977-78 was wetter and colder than average during December and January; correspondingly, accidents were more numerous during this period. The winter of 1979-80, however, was exceptionally mild and dry, resulting in fewer winter accidents.



ACCIDENT DATA
DATA REPRESENTS ALL ACCIDENTS RECORDED FROM 6/77 THROUGH 5/80
6/77 to 5/78 — 138 / 44%
6/78 to 5/79 — 110 / 35%
6/79 to 5/80 — 64 / 21%
Total — 312 / 100%
Injury Accidents
Accidents With Property Damage
Daytime Accidents
Nighttime Accidents
50
40
30
20
10
3rd & Central
1st Ave. to 4th Ave. on 3rd
3rd & J-T
3rd & Bypass
3rd & K-Mart
3rd & Division
3rd & 17th Ave.
3rd & 4th St.
3rd & Smelter
Smelter & 6th St.
Smelter & 8th St.
Smelter & 10th St.

FIGURE NO. 8

The intersections with the highest number of accidents were those at Third and Central (49) and Tenth and Smelter (48). These intersections both have large volumes of traffic and a high percentage of turning movements. The intersection at Third and Fourth, which is unsignalized, had the third highest number of accidents (36). This intersection includes an entrance to the Westgate Shopping Center, has a large percentage of turning movements, and also has inadequate nighttime lighting.

The large percentage of nighttime accidents occuring at the Tenth and Smelter intersection reflects a poor nighttime lighting system and the presence of the Red Barn Bar located immediately to the west. The area in the vicinity of the J - T Ranch House is also greatly affected by the nighttime land use.

According to Table No. 1, the Smelter Avenue portion of the corridor is by far the safest section (2.0 acc/mvm). This area has the fewest functional curb cuts and the most undeveloped land area within the corridor, with minimum side street traffic and conflicts. The Third Street NW section from the Bypass north to the Third and Smelter intersection has the highest daytime accident rate (8.4 acc/mvm). Located along this section are six eating establishments and a host of commercial and industry-oriented businesses. The accident rates reflect the use of the many curb cuts and access traffic in this area. This portion of the study corridor does not have a nighttime lighting system and, combined with poorly illuminated driveway entrances, has a high nightime accident rate (12.8 acc/mvm).

The section of street from the Central Avenue intersection to the Bypass intersection has a reasonable daytime accident rate of 2.0 acc/mvm and a high nighttime accident rate of 15.6 acc/mvm. Considering that this section of street has a good street lighting system, the high nighttime accident rate did not appear to be appropriate for this section at first. Detailed analysis, however, revealed that the majority of the nighttime accidents could be attributed to the J - T Ranch House and the Cowboy Bar, which are both located along this section of the study corridor. Removing these accidents from the analysis (since these accidents are more a function of land use than of the characteristics of the street) results in a more reasonable nighttime rate of 7.2 acc/mvm.

Table No. 2 indicates the accident rates of isolated intersections. The highest total intersection accident rate occurs at the unsignalized intersection of Third and Fourth (1.9 acc/mve). Note the high nighttime accident rate associated with the J - T area (6.1 acc/mve) indicative of the land use in that area. The table also shows the Tenth and Smelter (4.0 acc/mve) and the Third and Bypass (2.7 acc/mve) intersections as having high nighttime accident rates. Both of these intersections have inadequate lighting.

F. TRAFFIC CONFLICT STUDY

(1) Description and Purpose of Study

Traffic conflict studies are performed at locations that exhibit a high accident potential.

TABLE NO. 1

ACCIDENT RATES *

(By Section)

Location	Total Accident Rate	Daytime Accident Rate	Nighttime Accident Rate
Third Street Northwest (.606 mi.)			
Central Avenue North to the Bypass Intersection	5.5 acc/mvm	2.9 acc/mvm	15.6 acc/mvm (7.2 acc/mvm without bar traffic)
Third Street Northwest (.683 mi.)			
Third and Bypass north to the Third and Smelter intersection	8.4 acc/mvm	7.2 acc/mvm	12.8 acc/mvm
Smelter Avenue (.695 mi.)			
Third and Smelter east to the Tenth and Smelter intersection	2.0 acc/mvm	1.7 acc/mvm	3.1 acc/mvm

* Accidents per million vehicle miles traveled

TABLE NO. 2

INTERSECTION ACCIDENT RATES *

Location	Total Accident Rate	Daytime Accident Rate	Nighttime Accident Rate
Tenth St. North & Smelter Ave.	1.6 acc/mve	1.0 acc/mve	4.0 acc/mve
Third St. NW & Smelter Ave.	1.1 acc/mve	1.0 acc/mve	1.4 acc/mve
Third St. NW & Fourth St.	1.9 acc/mve	1.6 acc/mve	3.2 acc/mve
Third St. NW & Bypass	1.4 acc/mve	1.1 acc/mve	2.7 acc/mve
J - T Ranch House	1.4 acc/mve	0.1 acc/mve	6.1 acc/mve
Third St. NW & Third Ave.	0.8 acc/mve	0.1 acc/mve	0.7 acc/mve
Third St. NW & Central Ave.	1.3 acc/mve	1.1 acc/mve	2.2 acc/mve

* Accidents per million vehicles entering intersection

Two types of conflicts have been defined for use in this study: 1) evasive actions by drivers, such as lane changes or use of brakes to avoid a collision; and 2) traffic violations. Information resulting from this type of study is valuable in the analysis of an intersection with respect to geometrics, striping, signing, and traffic control.

Three intersections were studied: Tenth and Smelter, Third and Fourth, and Third and Seventeenth. Each location was observed during four hours of peak volume traffic.

(2) **Summary of Conflict Study**

The conflicts and violations were defined and tabulated, and a detailed listing of the study results is presented in Appendix C of this report. The conflicts and violations have been broken down according to individual intersection approach direction, and summarized in Table No. 3.

(3) **Interpretation of Study Results**

Table No. 3 shows the total number of conflicts and violations and the corresponding percentage of potential collisions and infractions compared to the total intersection approach volume.

The predominant conflict occuring at Third and Seventeenth involved delay and the possibility of rear-end collisions caused by vehicles turning into McDonald's. The majority of traffic violations at this location were caused by vehicles entering the corridor. Failure to stop on the east approach and turning into the wrong lane by both east and west approach vehicles were the most prevalent infractions. A violation unique to this intersection occured when vehicles in the south approach attempting to turn in at McDonald's swerved into the north approach lane and traveled down the wrong side of the median to the entrance to McDonald's. This maneuver is a result of the entrance signing system used by McDonald's, and is primarily caused by the designated entrance lying fifty feet north of the intersection.

The Third and Seventeenth intersection is also the primary entrance used by Rice Trucking Lines. The Rice trucks are not on a fixed departure schedule and have no apparent peak dispatch period. Approximately 16 semi-trucks enter or leave the Rice establishment each day. During the four-hour study period, only one Rice truck negotiated the intersection, and it did so without difficulty. Rice Trucking Lines has voiced concern over the potential for a major traffic accident at this intersection because of the flammable and sometimes explosive fluids (i.e., diesel, gasoline, jet fuel, etc.) carried by their trucks.

The south approach to the intersection of Third and Fourth is a primary entrance to Westgate Shopping Center. The most common violations in this intersection were failure to stop on the north approach and entering the corridor by turning into the wrong lane. The conflicts occuring in the east approach of this intersection are predominantly caused by the variety of turning movements occuring at this intersection. The most common conflict occurs when the east-bound traffic attempts to enter Westgate Shopping Center. Fifty-two percent of the traffic that enters Westgate

TABLE NO. 3

TRAFFIC CONFLICT STUDY SUMMARY *

Intersection	Intersection Approach Direction			
	North	South	East	West
Third St. NW & Seventeenth Ave.				
Conflicts:	54/3%	18/1%	1/0%	0/0%
Violations:	2/0%	23/1%	38/23%	41/18%
Third St. NW & Fourth St.				
Conflicts:	9/3%	6/2%	42/2%	310/16%
Violations:	83/23%	96/29%	1/0%	3/0%
Tenth St. & Smelter Ave.				
Conflicts:	3/0%	76/3%	1/0%	253/10%
Violations:	83/9%	136/5%	79/13%	103/4%

* Number of conflicts / percentage of approach volume

at this location does so by cutting through the Exxon service station located immediately adjacent to the designated shopping center entrance. This maneuver alters the original design traffic flow patterns and raises the accident potential within the Exxon service station and Westgate parking lot significantly.

At Tenth and Smelter, the major conflict is the danger of rear-end collision caused by eastbound traffic along Smelter attempting to negotiate a high-speed, high-volume right turn. The most common potentially hazardous violation involves the two parallel left-turn lanes provided for the south approach. Vehicles tend to drift from their turning lane into the adjacent lane, increasing the probability of a sideswipe accident. Better pavement markings would result in proper channelization of traffic and would eliminate many of these erratic maneuvers.

G. PEDESTRIAN AND BICYCLIST STUDY

(1) Pedestrian and Bicyclist Counts

Pedestrian and bicyclist counts were conducted at ten intersections along the study corridor. Counts were taken during six hours of peak traffic, and all counts taken at a location were performed on the same day. The volumes were recorded and tabulated according to approach direction. Figure No. 9 shows the total six-hour pedestrian and bicyclist volumes divided into two categories: volume traveling along the corridor (parallel approach), and volume approaching on a side street (perpendicular approach).

(2) Study Results

Figure No. 9 shows that the Third and Central intersection has the largest volume of both pedestrians and bicyclists. This location intersects the Central Avenue corridor of pedestrian and bicyclists, and consequently shows high volumes for all approaches.

For all count locations along the study route, the predominant direction of pedestrian flow is parallel to the corridor, with relatively low volumes on the side street approaches. The Smelter leg of the corridor is used as a bicycle travel way by residents of the northwest area. The physical characteristics of the roadway provide ample room for bicyclists, and no substantial conflicts between vehicles and bicycles were identified.

The higher pedestrian and bicyclist volumes recorded at Third and Division reflect the use of Division Road by residents of the northwest area as an access route to the K-Mart Shopping Center, as well as to the Westgate Shopping Center. An increase in the amount of mid-block crossings was noted in this vicinity. No crossing facilities exist at nearby intersections, contributing to the temptation to cross at mid-block.

(3) Special Studies

The Northern Montana State Fairgrounds property borders the corridor for approximately

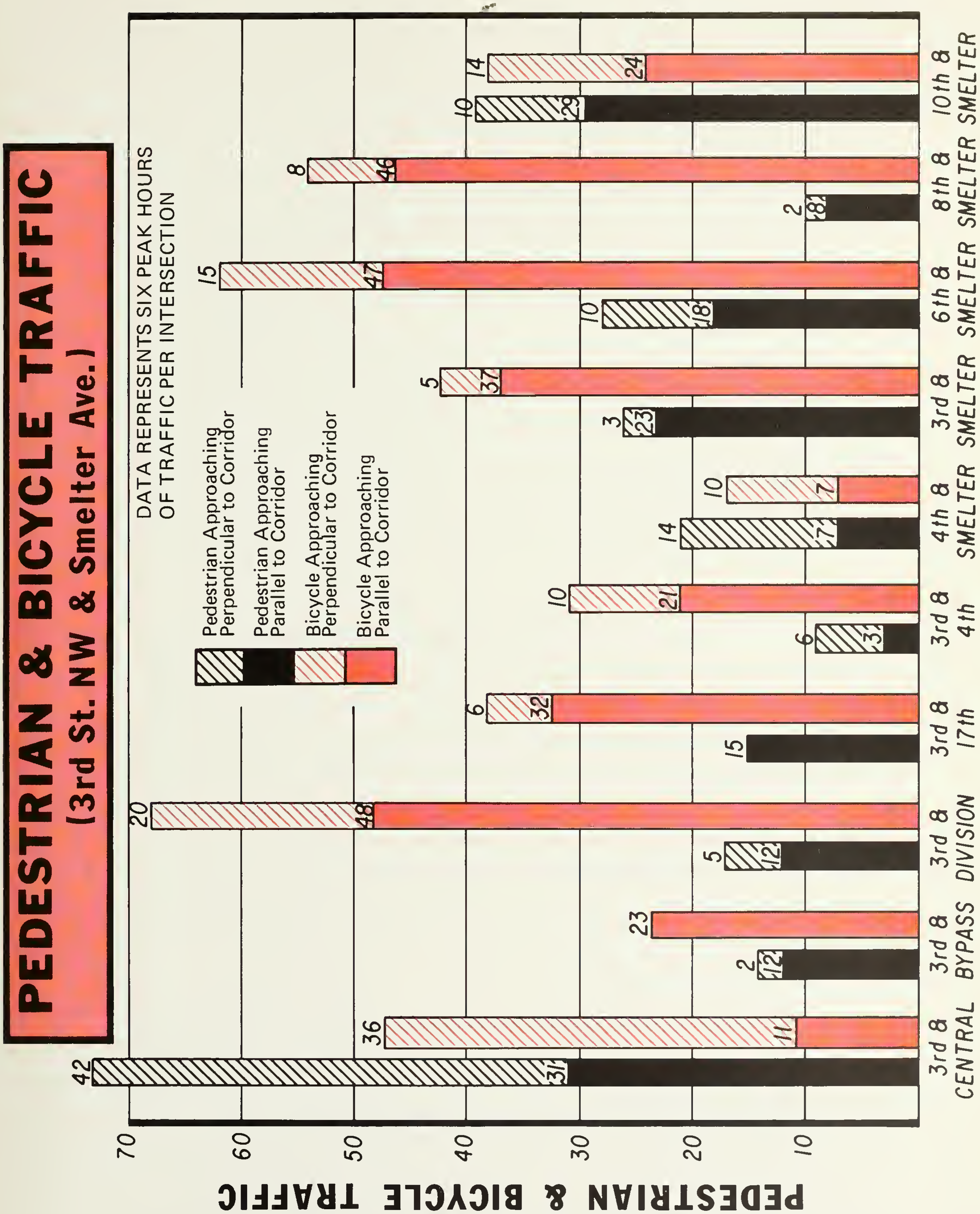

PEDESTRIAN & BICYCLE TRAFFIC
(3rd St. NW & Smelter Ave.)
DATA REPRESENTS SIX PEAK HOURS OF TRAFFIC PER INTERSECTION
Pedestrian Approaching Perpendicular to Corridor
Pedestrian Approaching Parallel to Corridor
Bicycle Approaching Perpendicular to Corridor
Bicycle Approaching Parallel to Corridor
PEDESTRIAN & BICYCLE TRAFFIC
3rd & CENTRAL
3rd & BYPASS
3rd & DIVISION
3rd & 17th
3rd & 4th
4th & SMELTER
3rd & SMELTER
6th & SMELTER
8th & SMELTER
10th & SMELTER

FIGURE NO. 9

3,000 feet on the west side between Central Avenue and the Bypass. This is a year-round facility with several events occuring weekly; the Montana State Fair also takes place here every summer. No major pedestrian or bicyclist volumes to and from the Fairgrounds were recorded throughout most of the year. However, during the two weeks surrounding the State Fair, pedestrian and bicyclist volumes are very high. On-street parking allowed on both sides of Third Street NW is heavily utilized during the Fair, and patrons use pedestrian entrances located at the east and south gates for access to the Fairgrounds. The east gate is exclusively a pedestrian entrance, and serves as many as 1,800 pedestrians per day during Fair Week. The south gate is primarily a motor gate, but during the Fair, approximately 800 pedestrians per day use this entrance. There are no existing pedestrian facilities in the vicinity of either entrance.

The Great Falls School District's Traffic Department was also contacted, and all school boundaries in the area were defined. The principal modes of student travel and the routes used were discussed. There are no residential areas between the Third Street NW study corridor and the Missouri River, and consequently no students have to cross the corridor in order to reach schools. All bus stops and travel routes are located within the residential areas and have a minimal effect on the study corridor. The school children observed using the study route were generally going to the shopping centers from their homes after school.

H. OFF-STREET CIRCULATION AND PARKING STUDY

(1) Field Inventory

An inventory was conducted in August, 1980 identifying the locations and sizes of existing parking facilities, individual parking needs, the locations of driveway entrances, and traffic circulation patterns. A total of 2,835 off-street parking spaces are available along the corridor. It should be noted that on-street parking is allowed on both sides of Third Street NW, but is rarely used except during Fair week. All of the business establishments along the corridor provide some form of off-street parking facilities for employees and patrons. The actual locations of curb entrances, parking lots and the number of parking spaces available at each particular establishment are shown on the aerial photographs in Chapter X.

(2) Problems Identified

The major problem identified with respect to off-street parking was that establishments with large parking areas have not effectively marked them to indicate a preferred circulation pattern. This leads to a random traffic circulation occuring in the lot, with resultant conflicts. In most cases, there is no channelization of traffic within the lot, and the entrances and exits are poorly marked.

Many businesses located on small lots have designed their facilities with a particular customer service in mind (i.e., drive-up windows, service station islands, etc.). The parking spaces provided are often limited and cramped. The circulation patterns created are often less than optimum,

and the exits and entrances are frequently placed at locations that create conflicts with the corridor traffic.

(3) Improvements Recommended

Business establishments should make appropriate modifications to the layouts of their parking areas in an effort to minimize traffic friction. All superfluous curb cuts should be eliminated according to the access plan outlined in Chapter VI. Entrances and exits to parking areas should be well defined, and parking areas should be marked to provide the best service to the establishment while promoting traffic channelization and the preferred circulation patterns.

All new applications for curb cuts should be reviewed in detail to assure that circulation patterns created will not conflict with the traffic flow along the study corridor.

IV.

LIGHTING SYSTEM ANALYSIS AND IMPROVEMENTS

A. Existing Street Lighting System
B. Lighting Design Criteria for Major Arterials
C. Lighting System Analysis
D. Interpretation of Results
E. Recommended Improvements

CHAPTER IV

LIGHTING SYSTEMS ANALYSIS AND IMPROVEMENTS

A. EXISTING STREET LIGHTING SYSTEM

A street lighting system has been installed on Third Street NW from Central Avenue to the By-pass. This system consists of 1000-watt high-pressure sodium vapor luminaires mounted 45 feet above the street. The light standards are alternately spaced along the corridor located outside of the roadway behind the sidewalk, and are evenly spaced at approximately 325 feet apart.

All signalized intersections along the study route are illuminated by several 1000-watt high-pressure sodium vapor luminaires. The locations of the lighting standards vary for each intersection and are shown on Figure No. 12 in Chapter X.

The non-signalized intersections along the corridor have little or no lighting facilities.

B. LIGHTING DESIGN CRITERIA FOR MAJOR ARTERIALS

The level and uniformity of illumination along a highway depend on several controlling factors, including the type and output of the light source, mounting height, spacing, and arrangement of lighting poles. The desired amount of light on the roadway can be obtained by using several different installation arrangements.

The two major factors used in evaluating roadway lighting are the level of illumination (the average level of horizontal illumination on the pavement area expressed in average footcandles), and the uniformity of illumination or Uniformity Ratio (the ratio of average footcandles of illumination on the pavement area to the footcandles at the point of minimum illumination).

According to the AASHTO report, *An Informational Guide for Roadway Lighting*, the design standards for a major arterial such as the Third Street NW study corridor are as follows:

Minimum Average Maintained Horizontal Footcandles	=	1.4
Illumination Uniformity Ratio	=	3:1 to 4:1

C. LIGHTING SYSTEM ANALYSIS

Light meter readings were taken at seven locations along the corridor using a General Electric Horizontal Footcandle Light Meter owned by the Montana Department of Highways. The exact meter locations and readings for each test are presented in Appendix D, "Lighting System Study Results".

Specific locations that were tested for street lighting are: all signalized intersections; the unsignalized intersection of Third and Fourth (due to a high nighttime accident rate); on the lighted section of the corridor near Third Avenue; and on the lighted section of the corridor near the J - T Ranch House.

The signalized intersections were tested to give a comparison between nighttime accidents and the adequacy of the street lighting. The intersection of Third and Fourth was tested to determine if there was any correlation between the high nighttime accident rate and the lack of illumination at this intersection. The test on the lighted corridor near the J - T was to determine the effect of a malfunctioning luminaire. The test near Third Avenue represented the average conditions along the lighted section of the street.

The lighting test results and nighttime accident rates for each test location are summarized in Table No. 4, below.

TABLE NO. 4

LIGHTING SUMMARY

Location	Average Maintained Horizontal Footcandles	Uniformity Ratio	Nightime Accident Rate (acc/mve)
Third Street NW & Central Avenue	0.93	4.40 : 1	2.22
Third Street NW & Third Avenue	1.15	2.56 : 1	0.7
Third Street NW at J - T Ranch House (One Luminaire Out)	0.76	19.0 : 1	6.1
Third Street NW & Bypass	1.15	28.73 : 1	2.68
Third Street NW & Fourth Street	0.29	14.67 : 1	3.2
Third Street NW & Smelter	1.28	1.94 : 1	1.44
Smelter & Tenth Street	0.49	3.27 : 1	4.0

D. INTERPRETATION OF RESULTS

The results of the lighting tests as contained in Table No. 4 show several deficient areas when compared to the AASHTO lighting criteria. An interpretation of the results for each location is as follows:

Third Street NW and Central Avenue: This intersection has an average illumination rate that does not meet AASHTO standards, although the uniformity ratio is satisfactory.

Third Street NW and Third Avenue: This location is indicative of the lighting system that was installed along Third Street NW from Central to the Northwest Bypass. The light intensity is slightly lower than that recommended by AASHTO, but the uniformity ratio is satisfactory.

Third Street NW at J - T Ranch House (One Luminaire Out): This location shows the effect that a missing luminaire has on the lighting system. The light intensity drops significantly below recommended levels, and the uniformity ratio is excessively high.

Third Street NW and Bypass: This intersection has illumination near the recommended intensity, but due to the placement of lights has an unacceptable uniformity ratio.

Third Street NW and Fourth Street: This intersection has insufficient illumination and a very poor uniformity ratio, resulting in an inadequate lighting system.

Third Street NW and Smelter: This location has very nearly sufficient illumination and a very good uniformity ratio for an acceptable lighting system.

Smelter Avenue and Tenth Street: This intersection has insufficient illumination but a good uniformity ratio. Additional lighting should be provided.

Routine maintenance should be performed on a regular basis in order to maintain the desired light output of a roadway lighting system. Dirt and dust within the luminaire greatly lower the lamp's efficiency. Lamp lumen depreciation also occurs as an irreversible process in high-pressure sodium units. Lumen output of the lamp steadily decreases with age, and only replacement of the lamp will return the lumen output to its original level. The units used on Third Street NW have an expected lamp life of four years. The Montana Power Company is under contract to perform this maintenance work, and last replaced the lamps in August, 1978.

E. RECOMMENDED IMPROVEMENTS

On the basis of the lighting system investigations and the interpretation of the results of the study, the following improvements to the street lighting system on Third Street NW are recommended:

1. Improve the intersection lighting at Third Street NW and Central, Third Street NW and Northwest Bypass, and Smelter Avenue and Tenth Street. In most cases this upgrading will consist of adding or rearranging lights to achieve a satisfactory illumination intensity and uniformity ratio.

2. The intersection of Smelter Avenue and Sixth Street has limited lighting facilities at present. The north approach to this intersection serves as access to a large residential area and should be lighted. Due to this function and the traffic volume at this location, a new 1000-watt high pressure sodium vapor luminaire is recommended to replace the existing 400-watt mercury vapor light.

3. The intersection of Eighth Street and Smelter Avenue presently has no lighting facilities. It is recommended that a 1000-watt high-pressure sodium vapor luminaire be installed at this location.

4. The section of Third Street NW from the Northwest Bypass to the Sixth and Smelter intersection has experienced substantial development in the past ten years. This section now has a number of commercial establishments and the largest number of curb cuts along the corridor, and does not currently have any lighting except that provided by the commercial establishments. It is recommended that a new street lighting system, continuing the existing system of 1000-watt high-pressure sodium vapor luminaires with 45-foot mounting heights, be provided for this section of Third Street NW. The recommended lighting system is shown on Figure No. 12 in Chapter X of this report.

5. In the future as development occurs along the corridor and additional lighting can be justified, the corridor lighting system can be extended from Third Street NW and Smelter Avenue to Smelter Avenue and Tenth Street.

V.

TRAFFIC SIGNAL SYSTEM ANALYSIS AND IMPROVEMENTS

A. Traffic Signals
B. Signal System
C. Summary

CHAPTER V

TRAFFIC SIGNAL SYSTEM ANALYSIS AND IMPROVEMENTS

A. TRAFFIC SIGNALS

(1) Introduction

The Third Street NW corridor currently has four signalized intersections. Several other in-intersections along the corridor may require signalization in the future. This chapter will analyze the operation of the existing traffic signals based on traffic flow characteristics and traffic safety requirements. The traffic signals will be analyzed individually and recommendations will be presented for improving operation and safety. The traffic signals will then be analyzed as a system, and the impact of future traffic on the corridor will be evaluated.

The existing traffic signals on the Third Street NW corridor are located at Third and Central, Third and Bypass, Third and Smelter, and Smelter and Tenth. The traffic signals are evenly spaced along the corridor and operate independently as isolated intersections.

None of the signalized intersections can be classified as typical since each has unique traffic flow conditions. Third and Central is a four-way intersection with the south approach being one way northbound and the main traffic flow on Central Avenue. Third Street NW at Northwest Bypass is a "T" intersection with the main traffic flow around the corner to and from the north. Third and Smelter is a "Y" intersection, which allows access to Third Street NW for eastbound traffic only on Smelter Avenue. Smelter and Tenth is a four-way intersection, but the major traffic movement is the northbound left turn onto Smelter Avenue.

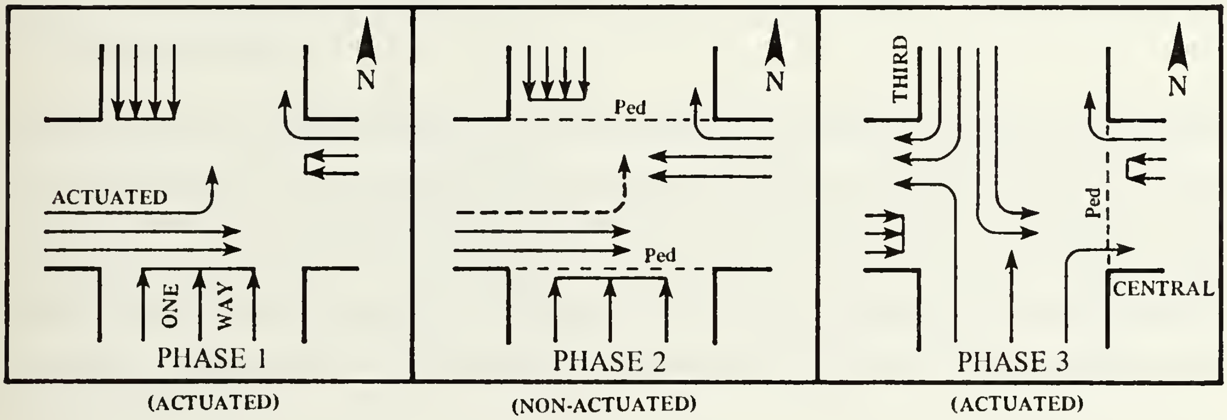
The traffic signals use both fully-actuated and semi-actuated operation to control the flow of traffic. Fully-actuated operation assigns green times based on actual traffic demand. The traffic demand is measured by the actuation of vehicle detectors located in the roadway. Fully-actuated operation is used in both system and isolated intersection control and is very effective in adjusting to changes in traffic flow. Semi-actuated operation assigns green times on a fixed basis for the non-actuated traffic movement and on a demand basis for the actuated traffic movements. Semi-actuated operation is used in systems during coordinated control but lacks the flexibility required to effectively control isolated intersections or system intersections when coordinated control is not required.

An analysis of signalized intersection operation must consider the movement of pedestrian traffic and operational safety, as well as the movement of vehicular traffic. While capacity analysis considers relative safety and pedestrian conflicts in establishing the operational levels of service, specific conditions at an intersection may require special consideration if the operation does not provide an acceptable safety level or has a high accident potential.

(2) Traffic Signal Analysis

Third Street NW at Central Avenue: The traffic signal at Central Avenue has three phases and is semi-actuated. Crosswalks exist on all approaches and pedestrians are served on a demand (pedestrian-actuated) basis. The signal is operated by an Econolite D-13000 controller unit. The major traffic flow is east – west on Central Avenue, with Third Street NW having moderate traffic southbound and very light traffic northbound.

PHASE SEQUENCE (EXISTING)
THIRD STREET NW AT CENTRAL AVENUE



The capacity analysis of this traffic signal shows that during peak hour traffic it operates at Level of Service B, which is stable traffic flow and a very acceptable capacity level. However, three conflict conditions exist at the intersection which need special consideration.

The first conflict condition involves the eastbound left turn lane from Central Avenue. This left turn is operated both as a protected (no conflict) and a permissive (unprotected) turning phase. While capacity analysis indicates that this operation is acceptable, accident records show ten reported accidents in the last three years due to this situation, which is not acceptable. The permissive left turn should be eliminated and replaced with a fully-protected turning phase.

The second conflict condition involves the north- and southbound vehicle movements. Double lane turning movements require extra driver concentration and are usually protected from other vehicle conflicts. Also, the through movement legally has the right of way over turning movements. At this intersection, however, the turning movment is not protected and the southbound turning vehicles, by force of numbers, take the right of way from the through traffic. The twin conditions of

an unexpected conflict and confusion over right-of-way produce a high potential for accidents, and six accidents of this type have been reported in the last three years. A separate phase should be added for the northbound traffic movements.

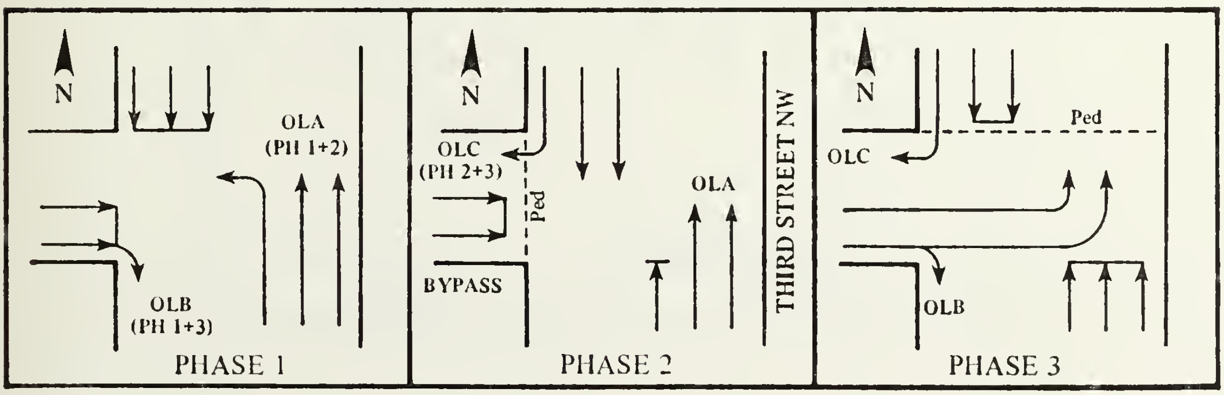
The final conflict condition concerns pedestrian conflicts with double turning movements. Pedestrians moving with a double turning movement often have their view of vehicles in the outside turn lane blocked by vehicles in the inside lane. This is also true of the view the vehicles in the outside lane have of the pedestrians. No pedestrian accidents have been reported, but it is felt that this condition has a high accident potential and should be eliminated. The pedestrian movements should be removed from phase three and placed on a phase added for the northbound traffic movements.

The existing controller unit is not capable of providing the suggested operational changes and would have to be replaced. In addition, some minor wiring changes would be required.

The Montana Department of Highways is planning to revise the traffic signal at this intersection in the future. The project plans indicate the suggested changes have been incorporated into the new traffic signal design.

Third Street NW at Northwest Bypass: The traffic signal at the Northwest Bypass has three phases and three overlaps (OL), and operates fully actuated. An overlap is a signalized traffic movement which is green during more than one phase. Crosswalks exist on the north and west approaches with pedestrian-actuated control. The traffic signal is operated by an Econolite D-4000 controller unit. The major traffic flow is eastbound to northbound onto Third and southbound to westbound onto the Bypass. Traffic entering the intersection is moderate from the east and south and moderate to heavy from the north.

PHASE SEQUENCE (EXISTING)
THIRD STREET NW AT NORTHWEST BYPASS



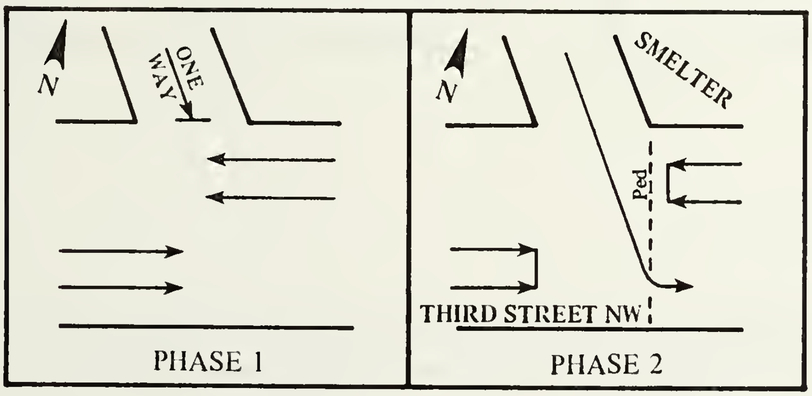
The capacity analysis of this traffic signal shows that during peak hour traffic, it operates at Level of Service A with free-flowing traffic.

While capacity is not a problem at this intersection, the double left turn movement on the Bypass and the crosswalk on the north approach require further consideration. Double turn lanes are not a normal condition at an intersection and can catch a driver by surprise if adequate warning is not given. Overhead lane use control signs, similar to the ones on the north approach at Central Avenue, give a more positive warning to drivers than the pavement markings presently used, and their installation is recommended.

Pedestrians using the crosswalk on the north approach walk concurrently with the double left turning movement from the Bypass and the right turn movement from Third. In addition to the visibility problem discussed at Central Avenue, this double turning movement is on a flat angle which allows higher-than-normal speeds. It is recommended that consideration be given to moving the crosswalk to the south approach, which would greatly reduce the potential for vehicle-pedestrian accidents.

Third Street NW at Smelter Avenue: The traffic signal at Third and Smelter has two phases and operates fully actuated. A crosswalk exists on the northeast approach only. The traffic signal is operated by an Econolite D-2000 controller unit. The major traffic flow is northeast and southwest on Third and is moderate to heavy. The Smelter Avenue approach is one-way eastbound and carries light to moderate traffic.

PHASE SEQUENCE (EXISTING)
THIRD STREET NW AT SMELTER AVENUE

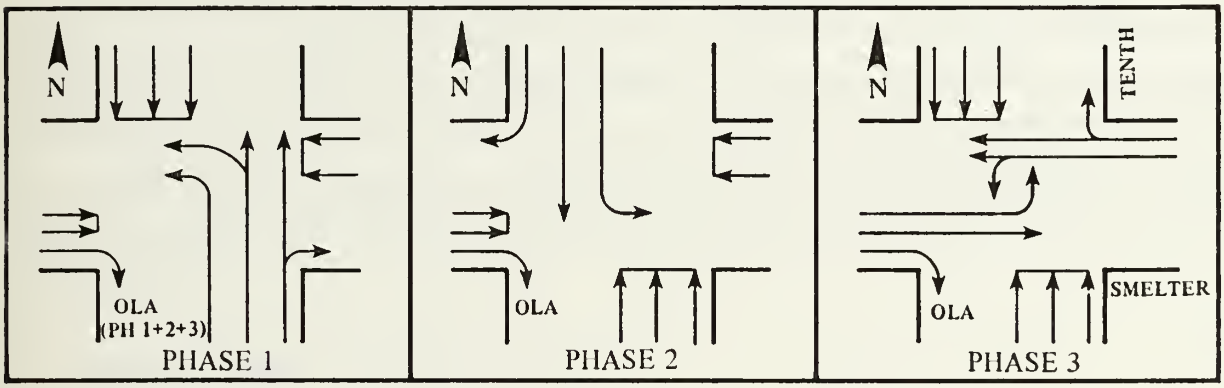


The capacity analysis of this traffic signal shows that during peak hour traffic, it operates at Level of Service A with free-flowing traffic.

The location of the crosswalk on the northeast approach, however, does create a high potential for vehicle-pedestrian accidents. Similar to conditions at the Bypass, pedestrians move concurrently with a relatively high-speed left turn movement. Consideration should be given to eliminating this potentially dangerous condition.

Smelter Avenue at Tenth Street: The traffic signal at Tenth Street has three phases with one overlap (OL), and operates fully actuated. No pedestrian control is provided. The traffic signal is operated by an Econolite D-4000 controller unit. The major traffic flow is northbound to westbound and eastbound to southbound between Smelter and Tenth, and is moderate to heavy. The eastbound and northbound through traffic is light to moderate. Through traffic flow southbound and westbound is also light to moderate.

PHASE SEQUENCE (EXISTING)
SMELTER AVENUE AT TENTH STREET



The capacity analysis of this intersection shows that during peak hour traffic it operates at Level of Service D to E, and is approaching unstable flow. This level of service is not acceptable and can be improved.

The major capacity problem is the double left turn on the south approach. This double turning movement has a tight turning angle of 104°, which increases the green time required for a given traffic volume. By signing the left and center lanes as left turn only, and providing 18-foot lanes to turn

into, the operational characteristics of the intersection could be improved to a Level of Service C, which is a stable traffic flow. These changes could be accomplished by restriping the intersection, and would not require any additional pavement width. These striping improvements are shown graphically on Figure No. 12 in Chapter X of this report.

The installation of overhead lane use control signs is also recommended on the south approach to provide advanced warning to drivers of the double turning movement.

Added efficiency of signal controller operation can be obtained by the installation of additional vehicle loop detectors between the existing detectors and the stop line on each approach. This will allow the initial and passage times for each phase to be kept to a minimum, thereby reducing "lost time".

Many theories exist on continuous detection. It is recommended that three additional six-foot loops be installed in the through and left-turn lanes on each approach, spaced approximately 20 feet apart. This would permit the controller timing for the initial interval and passage intervals to be set at approximately ½ second.

This intersection will approach the Capacity Level of Service by the year 2000. The overloading of the south approach and more specifically the handling of the large volume of left-turning vehicles will become the critical factor. Additional steps may be required to relieve congestion and backups on the south approach. Providing more vehicle storage for both left turn lanes by altering the median and approach lane configurations would be beneficial. Striping the north approach to facilitate two through lanes would minimize the green time necessary for that particular phase, thereby allowing more time for the south approach volume. It may also be necessary to install a multi-phase controller to handle the future demands. It is strongly recommended that a detailed intersection study be initiated at a time in the future when a more accurate assessment can be made of traffic demands on this intersection.

B. SIGNAL SYSTEM

(1) General

The Third Street NW corridor forms a link between Tenth Street on the east, Central Avenue on the south, and the Northwest Bypass. The primary traffic flow in the corridor is between Tenth Street and the Bypass, with secondary flow occuring between the Bypass and Central Avenue.

The existing traffic signals on the corridor are relatively isolated from each other with an average spacing of 3,500 feet. The traffic signals operate semi- and fully actuated without any signal system control. The traffic flow characteristics along the corridor range from unstable to free-flowing.

The Third Street NW corridor is a typical fringe area arterial with widely spaced traffic signals which provide good traffic flow at present without signal system control. However, as development and traffic growth occur along the corridor, more signals will be required. A general rule of thumb is that when traffic signal spacing decreases to a half-mile or less, strong consideration should be given to providing signal system control.

The major development and primary traffic flow on the Third Street NW corridor is occuring in the section between Tenth Street and the Bypass. A signal control system will be needed for this section if acceptable traffic flow is to be maintained as the traffic signal spacing decreases.

The only traffic signal on the corridor which is not in the signal system section is at Third and Central. Central Avenue West is a major east-west arterial and this traffic signal will have a major impact on a signal system for the Central Avenue corridor.

It should be mentioned that the long-range transportation plan for Great Falls includes a Northwest Bypass Bridge across the Missouri River. If constructed, the bridge traffic would most likely utilize the Third and Bypass intersection for access. According to the Department of Highways, funding limitations preclude the possibility of the bridge being constructed during the 20-year study period. Therefore, the effects of the bridge traffic on the study corridor have not been included in this report.

(2) System Analysis

The effective operation of a signal system is a function of the combined effects of traffic signal spacing, travel speed, and cycle length. Maximum efficiency is achieved when the relationship between these factors is optimized.

The relationship between spacing, speed, and cycle length is given by the equation:

$$S\,(Speed) = D\,(Optimum\ Spacing)\ /\ 0.735C\,(Cycle\ Length)$$

Based on this equation and using a travel speed of 35 mph, the Third Street NW corridor will operate at maximum two-way efficiency with the following combinations of signal spacing and cycle lengths.

Signal Spacing	Cycle Length
1179 ft.	46 sec.
1415 ft.	55 sec.
1769 ft.	69 sec.
2358 ft.	92 sec.

Three-phase traffic signals are normally operated with cycle lengths between 60 and 80 seconds. For the analysis of the study corridor, a 70-second cycle was used with an optimum signal spacing of 1800 feet.

Based on traffic counts and proposed development, five intersections in the corridor have a potential need for signalization. They are located on Third Street NW at Fourteenth Avenue, Division Road and Fourth Street, and on Smelter Avenue at Sixth Street and Eighth Street.

TIME-SPACE DIAGRAM FOR POSSIBLE SIGNAL LOCATIONS

(70 SECOND CYCLE - AVERAGE PROGRESSION)

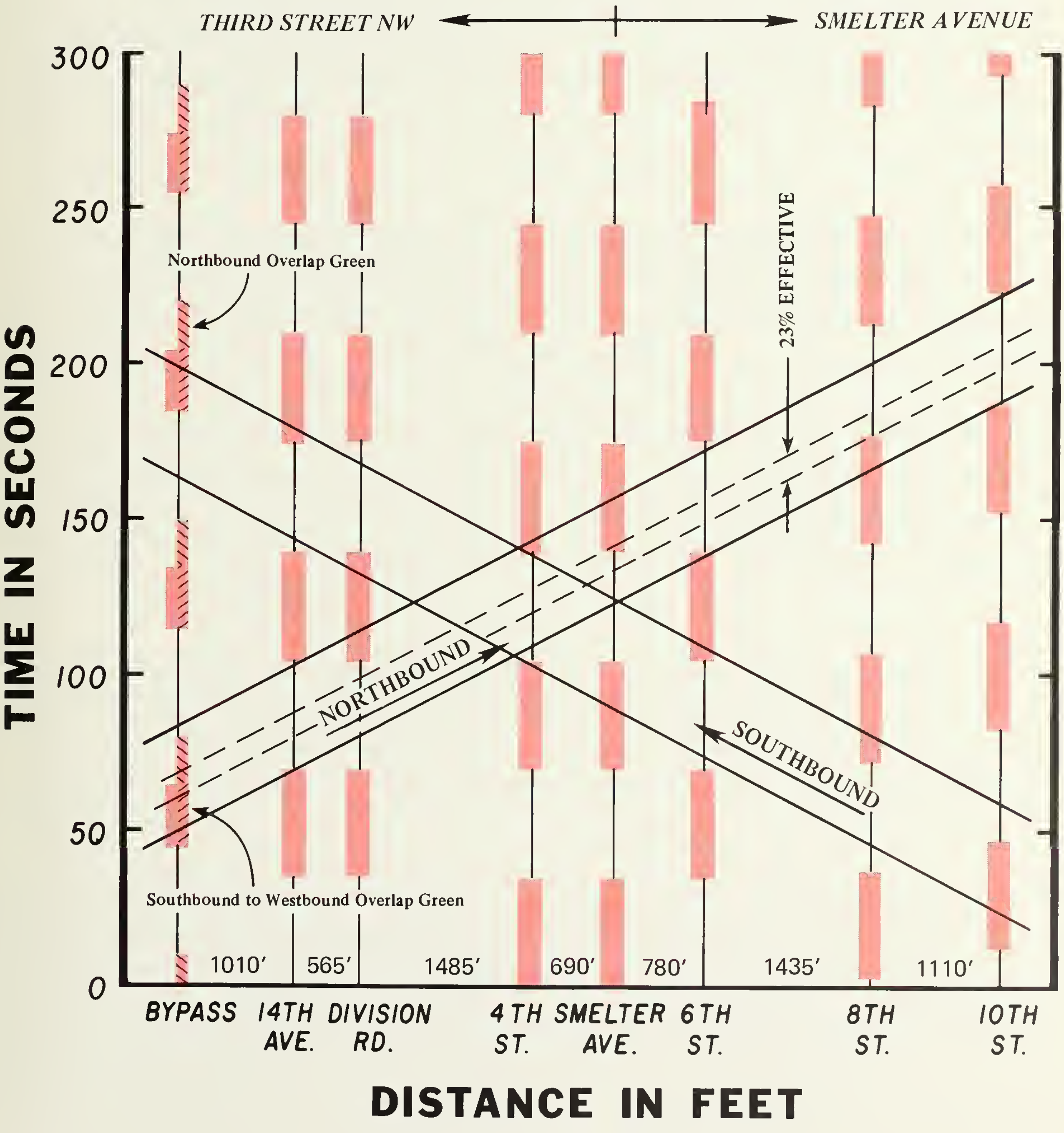


FIGURE NO. 10

Figure No. 10 is a time-space diagram for the corridor. The diagram depicts a 70-second cycle with a 35 mph travel speed, and shows both existing and potential traffic signal locations. A full-band width is shown for comparison purposes and a 50 percent cycle split was used for simplification. The through bands are terminated in red periods at the Bypass and Tenth Street because traffic at these locations will be progressed around the corner on the "side street" phases.

(3) **Recommendations**

An examination of Figure No. 10 shows that if all of the existing and potential traffic signals on the Third Street NW corridor were in operation under the control of a signal system, the through green band would be only 23 percent of the total green band available. Eighty percent of green band usage can be achieved by systematic selection of traffic signal locations based on optimum signal system operation.

Third Street NW at Fourteenth and Division Road: Traffic signals at both of these locations would seriously limit green band usage. One of these locations could be selected for a traffic signal but not both. A signal at Fourteenth Avenue would provide the most efficient green band usage. A signal at this location will meet warrants in the year 1990, approximately.

Third Street NW at Fourth Street: A traffic signal at this location would operate effectively in the signal system. Signalizing this intersection would also provide for the large volume of turning movements that occur at this location. This intersection will meet the signal warrant requirements in 1990. It is recommended that signalization of the Fourth Street intersection coincide with the removal of the signal at Third and Smelter.

Third Street NW at Smelter Avenue: This is an existing traffic signal and it will not operate very effectively in the signal system. Consideration should be given to removing the traffic signal. The traffic could be re-routed through the signal at Fourth Street. This signal should be removed at the time a signal interconnect system is installed. It is estimated that this form of signal control would be beneficial at about 1990.

Smelter Avenue at Sixth Street and Eighth Street: A traffic signal at Sixth Street would be preferred over the location at Eighth Street because it would provide better green band utilization. This intersection should be signalized in conjunction with a signal interconnect system. If the signal at Third and Smelter were simultaneously removed, the Sixth and Smelter intersection would meet signal warrants in the year 1990.

TIME-SPACE DIAGRAM FOR PROPOSED SIGNAL LOCATIONS

(70 SECOND CYCLE - AVERAGE PROGRESSION)

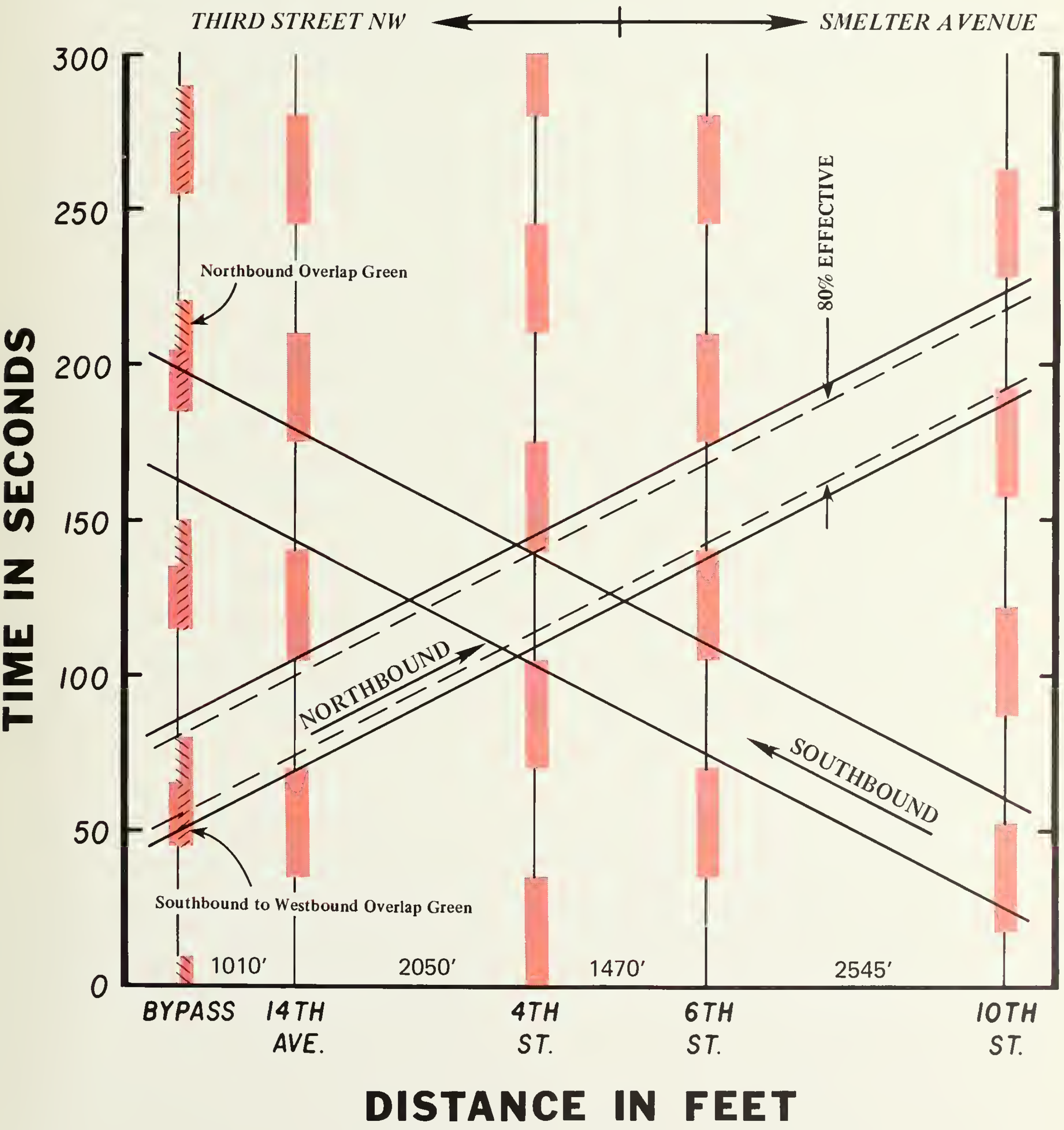


FIGURE NO. 11

(4) Future System Overview

The time-space diagram for the system with the proposed signal locations is shown in Figure No. 11.

The distance between Central Avenue West and the Northwest Bypass is too great to maintain a platoon of cars for northbound traffic. Furthermore, the vehicles at Central Avenue are entering the corridor on two phases and a free right turn, which creates random arrivals at the Bypass.

By proper coordination, the vehicles entering the corridor from the Bypass as well as a large percentage of the vehicles from the south can be progressed satisfactorily through the corridor.

The location at Fourteenth fits nicely into the system and would serve the existing K-Mart store, C.M. Russell High School, and the future Travel Lodge as well as the residential area west and north of this intersection.

The Fourth Street and Sixth Street locations would serve the residential area north of Smelter Avenue. The Fourth Street location would also provide a safer entrance and exit from the Westgate Shopping Center.

It is expected that signalization of these two intersections would coincide with the removal of the signal at Third and Smelter. The running right turn at Third and Smelter could easily be retained to accomodate the northwest-bound traffic, as it presently does. The approach from the northwest on Smelter could be controlled by a stop sign or could be completely removed. The existing appraoch volume would be redistributed between the Fourth and Sixth street intersections with the majority of the traffic using Fourth Street. Widening Fourth Street would probably be required to handle the increased volume; however, no physical alterations to the Sixth Street intersection would be required.

The large number of vehicles entering the corridor at Tenth Street would be able to progress very nicely through the proposed system. There would be some stoppage of late-arriving vehicles desiring to proceed south through the intersection at the Bypass. By proper timing, the majority of this traffic, as well as the large south-to-west volume of traffic, will be able to clear the intersection.

(5) System Development Costs

The basic elements of a traffic-adjusted signal system are a master controller unit, an interconnect circuit, local coordination units, and local controller units. The estimated cost of implementing a traffic-adjusted signal system on the Third Street NW corridor with five traffic signals is given in the following tabulation:

Master Controller Unit		$15,000
Interconnect Circuit (underground)		$70,000
Local Coordination Units	$3,000 x 5 =	$15,000
Local Controller Units.	$7,000 x 5 =	$35,000
	Total	$135,000

This total system cost assumes replacement of existing controller units and the use of an underground conduit system for the interconnect circuit. Some reduction in cost could be achieved by using existing local controller units and by using an overhead or leased (telephone) interconnect circuit.

A recent development in signal system control equipment is the Time Base coordinator. A Time Base coordinator uses an accurate digital clock to coordinate the operation of traffic signals in a system. The major advantage of a Time Base system is that an interconnect circuit and master controller unit are not required. The major disadvantage is the lack of adequate field testing of the operational reliability of the unit.

The estimated cost of a Time Base system for the study corridor is:

Local Coordination Units	$6,000 x 5 =	$30,000
Local Controller Units.	$7,000 x 5 =	$35,000
	Total	$65,000

C. SUMMARY

The traffic signals on the Third Street NW corridor are currently capable of providing acceptable traffic flow characteristics. Recommendations have been presented for improving the operational and safety characteristics of the individual traffic signals.

An increase in development and traffic growth along the Third Street NW corridor, especially in the section between Tenth Street and the Bypass, will eventually require consideration of a signal control system. Recommendations have been presented on how to optimize the operation of a signal system when one is required.

ACCESS PLAN

A Introduction
B. Driveway Access Inventory
C. Access Plan and Recommendations

CHAPTER VI

ACCESS PLAN

A. INTRODUCTION

The method of access used to service business establishments along the corridor has a dramatic effect on the efficiency and safety of the roadway. Access to the Third Street NW corridor is presently provided by at-grade street intersections and driveway curb cuts. Mid-block traffic conflicts now occuring generally result from patrons entering and exiting adjacent businesses. The proper placement of curb openings can effectively channelize traffic, minimize delays, reduce friction and potential conflicts, and improve the safety characteristics of the roadway. The criteria outlined in this chapter were used to evaluate all existing curb cuts along the corridor and should be used to assess any future access applications.

B. DRIVEWAY ACCESS INVENTORY

An inventory of all existing driveway accesses was conducted on July 30, 1980. This inventory revealed a total of 94 curb cuts. The average business has two curb cuts, with only a few establishments having more than two. Of the 94 curb cuts, six provide access to vacant land.

C. ACCESS PLAN AND RECOMMENDATIONS

The Third Street NW corridor serves as access to a large number of commercial and industrial sites with a variety of access needs. With these needs in mind and with a desire to improve the flow characteristics of the corridor, the following criteria were established to evaluate each individual curb cut:

1. If a curb cut services a parcel of vacant land or is not presently being used for access, it should be removed. In the development of a piece of abutting property, the establishment should create an internal traffic circulation and parking plan with a particular curb access arrangement in mind. The property owner should then file an application with the Department of Highways for a Driveway Access Permit. The application should be reviewed in detail with respect to the local geometrics, sight distances, internal flow characteristics, potential friction or conflicts, and the individual access needs of the applicant. If no apparent problems are identified, the access size and location should be specified and the construction of the curb cut inspected to assure proper implementation.

2. Where practical, all driveway accesses located closer than 50 feet from an intersection should be removed. The areas with the highest accident rates are generally in the immediate vicinity of

an intersection. Proper control of the location of curb cuts near intersections will result in reduced accidents, improved channelization, better flow characteristics and more predictable intersection turning movements.

3. If parking and circulation patterns are not adversely affected and local geometric and physical characteristics permit, access to the property should be obtained from a side street instead of the main corridor whenever possible. The preferred method of access to the corridor is at a street intersection.

4. Where practical, when two adjacent businesses could be served by a common curb cut instead of separate accesses for each business, the driveways should be combined. Adjacent businesses could coordinate their internal traffic patterns, if compatible, to permit the use of a common access.

5. Business establishments with excess curb entrances should have these entrances examined and non-critical ones eliminated. Each abutting parcel of property should be served access with the minimum number of curb cuts that will effectively accomodate the specific needs of the property owner.

Of the 94 existing curb cuts, 21 should be removed. Those accesses to be removed are shown on Figure No. 12 in Chapter X.

It is emphasized that these recommendations are based on the evaluation criteria described in this Access Plan and on the judgment of the evaluator. The property owners involved should be allowed to offer comments on any of their specific functional needs prior to the final decision on the driveway accesses.

It should be noted that several businesses that had been identified as having special access needs were contacted during the course of the study. The management of Rice Trucking conveyed their concern over the potential hazards of truck-related accidents involving flammable or explosive material. Although, on the average, only 16 Rice trucks pass through the Seventeenth Avenue intersection each day, they have difficulty clearing the intersection without interfering with the corridor traffic because of their length.

The specific access problems of McDonald's were discussed with the manager, but due to a lack of authority on her part, her comments were limited and did not necessarily reflect the attitude of the McDonald Corporation.

The manager of the Exxon Service Station and the President of the Westgate Shopping Center Owners' Association were also interviewed, and the problems related to the shopping center access at the Fourth Street intersection were discussed. There were no major objections to the closure of the Exxon Station's easternmost driveway curb cut or to any of the other proposed geometric modifications to that location.

VII.

GEOMETRIC DESIGN IMPROVEMENTS

A. Introduction
B. Recommended Improvements

CHAPTER VII

GEOMETRIC DESIGN IMPROVEMENTS

A. INTRODUCTION

The primary objective of roadway geometrics is the proper channelization of traffic in order to promote orderly movement, provide sufficient capacity, and encourage safety. The existing physical street features have been examined and problem areas have been identified. Each problem area is described below and the recommended improvements discussed.

The Third Street NW corridor has an 88-foot wide roadway surface consisting of four driving lanes divided by both raised and painted medians for channelization. Parking lanes and curb and gutter are provided on both sides of the corridor for its entire length. Sidewalks are provided on one side of the street for most of the length of the corridor. Driveway accesses provide access to abutting properties. The facility lies within a right-of-way width varying from 105 to 120 feet.

The existing street and recommended improvements are shown on Figure No. 12 in Chapter X of this report.

B. RECOMMENDED IMPROVEMENTS

Problem areas have been identified along the corridor and recommended improvements to remedy the situation for these areas are as follows:

(1) Medians

Medians provide channelization and regulate traffic flow. Therefore, median arrangements should be designed to favor desired circulation patterns and turning movements and prohibit erratic and hazardous movements.

The existing median system utilizes a combination of both raised and painted medians. It is recommended that painted medians be used in areas where channelization problems are minimal. In the vicinity of all major intersections and in areas with high turning movement volumes, however, raised medians should be used. The type and locations of all medians and recommended modifications to the existing system are shown on Figure No. 12.

(2) J - T Ranch House

The roadway adjacent to the J - T Ranch House has the highest nightime accident rate of any area along the corridor. This accident rate is primarily a factor of the specific land use and the predominant methods of access and egress. Presently, access is attempted through the use of four driveway curb cuts. However, patrons currently exit anywhere along the road frontage by driving over the curb. To better control this situation, the access should be limited to two curb cuts. It is

also recommended that pin down curbs be installed behind the existing curb and gutter on the edge of the parking lot. This should effectively channelize the vehicles to the designated driveway entrances and eliminate the curb-jumping and erratic turning movements that presently occur.

(3) Third and Bypass Intersection

Modifications to the median on the north approach should be implemented (see Figure No. 12). The present median arrangement was designed to allow for a railroad crossing that no longer exists. The gap in the median allows vehicles to make undesirable turning movements at a location where predictable traffic flow and channelization are required. The closing of this median gap will alleviate this potentially hazardous situation.

At present, a driveway access to the Empire Steel property is located within this intersection. It is not possible to eliminate this driveway opening without isolating the parcel. If a change in land use occurs in the future such that this curb cut could be eliminated, this action should be taken.

(4) Westwood Development

A new Travel Lodge motel and several condominium units are presently under construction north of the K-Mart Shopping Center. Included in this development project is the construction of Fourteenth Avenue. This development will be situated between Division Road and Fourteenth Avenue, and is scheduled for completion in 1981. It is recommended that access for these new facilities be provided by the two adjacent streets and not directly into Third Street NW. The northern-most driveway access to K-Mart should be removed, and access should be provided from Fourteenth Avenue.

(5) Third and Seventeenth Intersection

A traffic signal warrant investigation was conducted for this intersection. The results of this investigation showed that this intersection lacks the basic criteria required for signalization as provided in the *Manual on Uniform Traffic Control Devices.*

The McDonalds property, which is adjacent to this intersection, exhibits traffic circulation patterns that conflict with the overall flow characteristics of the corridor. This friction is caused by the inability of north-bound patrons to enter McDonalds through its southern-most driveway access, which is presently designated as an exit only. At the present time, the desired internal flow at McDonalds is in a counter-clockwise direction to facilitate a drive-up window. It is recommended that McDonalds be encouraged to re-sign their southern-most entrance to allow access at this driveway curb cut. It is also recommended that the internal traffic circulation pattern be modified as shown on Figure No. 12.

The median south of this intersection should be striped to include a turning bay to lessen the friction caused by turning movements.

It is also recommended that areas in the vicinity of this intersection be signed "No Parking" in order to maintain proper sight distances (see Photograph No. 1).

(6) Third and Fourth Intersection

It is recommended that the Burger Master establishment located adjacent to this intersection sign its western-most driveway curb cut as an exit only. This signing will reduce the number of hazardous turning movements by northbound patrons trying to enter at this location (see Photograph No. 2).

An entrance to the Westgate Shopping Center is also located at this intersection. At the present time, 52 percent of all northeast-bound patrons use the Exxon Station's driveway curb cut as access to the shopping center (see Photograph No. 3). To correct this hazardous situation, it is recommended that the Exxon curb cut be removed. The Westgate entrance should be widened and better delineated, and a turning lane for northeast-bound patrons should be provided. Improved nighttime lighting of the shopping center entrance is also recommended.

(7) Westgate Shopping Center

Three driveway entrances serve Westgate from the study corridor. Improvements to the western-most entrance were stated previously in section (6). The other two entrances should also be modified to encourage safe access and egress by improvements to the pavement markings, signing and nighttime lighting (see Photograph No. 4). The eastern-most entrance should be altered to provide a more perpendicular approach alignment to the corridor. All three entrances should be widened with curbing installed to provide channelization in the entrance approach. Lane markings and stop lines should be applied at each entrance. "Stop" signs are also recommended at all the driveway openings in an effort to discourage high exit speeds. Sidewalk facilities are recommended for the south side of the roadway from the Fourteenth Street intersection to the Sixth Street intersection. This improvement will accomodate pedestrian traffic in the vicinity of the shopping center.

(8) Tenth and Smelter

The raised medians in the vicinity of the Tenth and Smelter intersection were landscaped in the summer of 1980. The summer irrigation of the landscaped areas is automated on timers that water from 7:00 a.m. to 8:00 a.m. During observation of this intersection, it became evident that a traffic hazard was being created due to the watering of the grass and shrubbery on the medians. Excess water seeps from under the medians onto the roadway, and as a result the pavement is often wet until mid-afternoon (see Photograph No. 5). During the traffic conflicts study performed at this location, many conflicts were directly attributed to this wet pavement (i.e., erratic lane changes to avoid wet spots, skidding on wet pavement, dramatic speed changes approaching wet areas). It is also noted that a more rapid deterioration of the pavement will occur due to moisture contamination

PHOTOGRAPH NO. 1

Example of sight distance limitations caused by on-street parking at Third and Seventeenth.

PHOTOGRAPH NO. 2

Burger Master driveway access to be signed exit only. Note sight distance limitations caused by on-street parking.

PHOTOGRAPH NO. 3

Vehicles entering Westgate Shopping Center through Exxon Service Station.

PHOTOGRAPH NO. 4

Confusion and delays are caused by the lack of proper entrance identification at Westgate Shopping Center.

PHOTOGRAPH NO. 5

Wet pavement caused by median irrigation at Tenth and Smelter.

PHOTOGRAPH NO. 6

Increased deterioration of roadway surface caused by moisture seepage under median at Tenth and Smelter.

of the subgrade materials by this runoff (see Photograph No. 6). The irrigation techniques should be modified to prevent the wetting of pavement areas and to eliminate this hazardous situation. It is recommended that the watering cycle be shortened to the point where no excess water seeps into the roadway. Watering should be done during the night when evaporation loss is lowest. In this way, potential interference with motorists is minimized and water is conserved.

(9) West Bank Park Development

The construction of a city park along the west bank of the Missouri River is scheduled for the near future. Several access points along Third Street NW are being considered, including Second Street, Third Street, and a point adjacent to the J - T Ranch House and the County Shop property. The Second Street access would not provide a very direct route to the park area and would most likely be ineffective. The Third Street intersection is undesirable due to inadequate site distance at this location. The access location south of the J - T Ranch House has adequate sight distance and would provide a direct route to the park. This location would not create a major conflict with the corridor traffic and is considered to be the best point of access to the West Bank Park.

VIII.

SIGNING AND STRIPING PLAN

A. Introduction
B. Signing
C. Striping

CHAPTER VIII

SIGNING AND STRIPING PLAN

A. INTRODUCTION

Traffic control signs and pavement markings are important devices used to convey information, warning or guidance to motorists. The proper application of striping and signing can reduce accidents, regulate traffic flow, channelize vehicles and effectively increase the efficiency of a roadway. The existing traffic signs and pavement markings on the Third Street NW corridor have been examined, problem areas identified and modifications recommended. The signing and striping plan is depicted graphically on Figure No. 12 in Chapter X of this report.

B. SIGNING

(1) Speed Limits

At present, the corridor is signed 40 mph throughout. Considering the average travel speeds recorded in the Travel Time and Delay Study, this speed limit appears to be effective and appropriate for the roadway.

(2) Median Delineation

Third Street NW utilizes a combined system of both raised and painted median islands. The effectiveness of these traffic control devices can be supplemented by the use of effective signing as a means of informing, warning and controlling drivers. It is recommended that all narrow raised medians be delineated by the use of reflectorized object markers to emphasize the location of the island nose. The median curb face should be painted yellow to further identify the island shape and location. "Keep Right" guidance signs should be placed on the approach ends of all wide medians and at locations where additional channelization is required. All signs placed on median islands should be of the breakaway variety to minimize vehicle damage and injuries if struck by a vehicle.

(3) Lane Use Control Signs

The motorist should be given additional guidance on the approach to intersections that have a unique geometric layout or a special turning lane usage. It is recommended that a combination of overhead and post-mounted lane use control signs be used at intersections where vehicles are required to perform turning movements from specific lanes. The intersections at Third and Central, Third and Bypass, and Tenth and Smelter have unique turning lane combinations, and the application of the lane use guidance signs at these locations will minimize confusion, reduce intersection delays, and promote improved traffic flow.

(4) No Parking Signs

At present, on-street parking is permitted on both sides of the roadway throughout the entire length of the corridor, with few exceptions. In many cases, the parked vehicles represent a potential hazard as reflected by the number of accidents occuring which involve a parked vehicle. In areas with high accident rates involving parked cars, it is recommended that on-street parking be limited. It is also recommended that portions of the roadway be signed "No Parking" where sight distances could be impaired by the presence of a parked vehicle. The areas where on-street parking restrictions are recommended have been identified on Figure No. 12 in Chapter X of this report.

(5) Pedestrian Crosswalk Signs

Pedestrian crossings have been recommended at the intersections of Third and Fourth and Sixth and Smelter. These crosswalks should be properly signed in accordance with the *Manual on Uniform Traffic Control Devices.*

(6) Railroad Crossings

Immediately north of the Third and Central intersection, the corridor crosses a Milwaukee Road railroad track and two Burlington Northern tracks. Presently, these tracks are identified by the use of advance warning signs, pavement markings, and a pole-mounted flashing light signal system. The past several years have seen a reduction in the usage of these tracks, and at present crossings are rare. Intersection conflicts at Third and Central resulting from trains crossing on these lines are expected to be minimal. The existing railroad crossing signs, markings and control systems appear to be adequate and efficient. If in the future rail traffic were to increase significantly, modifications to the control system might be in order.

C. STRIPING

(1) Lane Dividers

Lane lines are used to separate lanes of traffic traveling in the same direction. Lane lines are usually broken white lines which permit lane changes. On the approach to an intersection, solid white lines should be used to provide additional channelization and prohibit lane changes. Presently, the driving lane closest to the median is striped 14 feet wide, with the outer driving lane being 12 feet wide. A ten-foot parking lane is also provided adjacent to the curb. Approach lanes to the intersection vary from 11 to 15 feet in width. The present lane marking system as detailed in Figure No. 12 appears to be adequate.

(2) Intersection Stripes

Each major intersection has distinct approach lane needs. In all cases, it is recommended that "Onlys" and directional arrows be placed on all approach and turning lanes to help the motorists negotiate the intersection. At the Third and Central, Third and Bypass, and Tenth and Smelter

intersections, it is recommended that turning lane markings extend through the intersection to assist in channelizing traffic where multiple turning lanes exist. Refer to Figure No. 12 for the exact locations of the turning lane extensions.

(3) Medians

Traffic control islands delineate the travel corridor, improve channelization, control turning movements, divide opposing streams of moving traffic, and provide lane storage for vehicles turning at intersections. The proper usage of median islands can greatly improve the flow characteristics of a roadway. Raised medians were discussed in Chapter VII and should be used in areas where additional channelization is required or where turning movements present a hazardous situation. Painted medians should be used in all other locations.

It is recommended that openings and turning lanes be provided at all locations where high volumes of turning movements exist. It is also recommended that the painted medians be striped with a double-wide line width to better accentuate the median area. Figure No. 12 contains the details of median location and shape.

(4) Crosswalks

Crosswalk markings provide guidance to pedestrians and warning to motorists. Crossing facilities should be provided at locations where pedestrians and bicyclists normally cross the corridor. Crosswalk markings should not be used indiscriminately, since unnecessary crosswalks reduce the effectiveness of those that are used regularly.

The intersections of Third and Central, Third and Bypass, and Tenth and Smelter should be marked with crosswalks to better delineate the proper crossing points. Pedestrian "Walk - Don't Walk" signal heads are in-place and functional at these intersections.

The intersection at Third and Smelter is equipped with pushbuttons and pedestrian heads, although the intersection is not striped for a crosswalk. During the entire observation of this intersection, this facility was never used. It does not appear that a crossing at this location is warranted, and it is recommended that the existing pedestrian heads be removed.

Pedestrian crosswalks should be placed at Sixth and Smelter and Third and Fourth, both of which are unsignalized intersections. Signing and marking these locations will best facilitate the needs of the residential community to the northwest in crossing the corridor to the Westgate Shopping Center.

A graphic display of the recommended markings is presented in Figure No. 12 in Chapter X of this report.

(5) Turning Bays

The intersection of Third and Fourth Streets is the location of a major entrance to the

Westgate Shopping Center. This entrance is the scene of a large volume of erratic entering movements, specifically the high-speed trespass across the Exxon station property. In an effort to provide better delineation of the proper entrance and the preferred entering method, a turning bay is recommended for the west approach leg to the intersection. Through the use of the turning bay, storage space is provided for turning vehicles, friction on the corridor is minimized, entrance speeds are reduced, and a potentially hazardous situation is alleviated.

(6) Railroad Crossings

Pavement markings should be applied in the vicinity of the railroad crossings near Third and Central. These markings provide the proper warning and stopping locations to motorists. Although train crossings on these lines are rare, they should be marked according to the *Manual on Uniform Traffic Control Devices*. The recommended marking layout is shown on Figure No. 12 in Chapter X.

(7) Current Marking Methods

A variety of pavement marking products are on the market with a wide selection of installation costs and services lives. Standard roadway paint is the least expensive to apply but is relatively short-lived. Epoxy paints, raised plastic stripes and thermoplastic products offer greater service lives at greater application expense. It is recommended that all lane striping, median markings and curb delineations consist of standard white and yellow roadway paint. All intersection approach lanes, stop lines, crosswalks, words and symbols should be of a raised marking material. It is felt that the use of the more durable roadway marking product which is still highly visible on wet pavement is desirable in the vicinity of potential conflict areas (i.e., intersections, crosswalks, railroad crossings, etc.).

IX.

CAPACITY ANALYSIS AND FUTURE REQUIREMENTS

A. Introduction
B. Service Level and Capacity
C. Interpretation of Study Results

CHAPTER IX

CAPACITY ANALYSIS AND FUTURE REQUIREMENTS

A. INTRODUCTION

In the analysis of an urban roadway's capacity, at-grade intersections are generally the limiting factors affecting the overall operational characteristics. An examination of the physical features of the Third Street NW corridor reveals that the major intersections control the capacity of the entire route. The existing roadway dimensions and lane striping provide ample lane widths for mid-block capacity. Therefore, the capacity analysis performed for this study was limited to the four signalized intersections where major flows of traffic intersect and the capacity limits of the corridor are established. The capacity analysis has been performed in accordance with the Highway Research Board's Special Report 87, "Highway Capacity Manual". The actual capacity calculations are on file with the Department of Highways Planning and Research Bureau.

B. SERVICE LEVELS AND CAPACITY

For the purpose of this analysis, it was assumed that each intersection would be completely loaded and the fully and semi-actuated signals would allow the maximum green time available for all approaches. Other factors considered in establishing the capacity were existing lane widths, the peak hour factor, adjustments for metropolitan area size and location within the metropolitan area, the percentage of trucks and buses, and pedestrian usage.

The level of service is determined by comparing the existing approach volume to the approach capacity. Service Level A represents the free flow situation with no signal cycles being loaded and no vehicles waiting for more than one red cycle to proceed through the interesection. Capacity occurs at Service Level E, when all signal cycles are fully loaded, delays become excessive, and unstable flow conditions exist. Service Levels B, C and D represent conditions between free flow and capacity. Service Level F represents a forced flow condition.

The approach volumes used to evaluate each location were based on turning movement counts taken in August of 1980. The raw data was factored to represent the 1980 A.D.T. for each intersection approach. The Year 2000 volumes supplied by the Department of Highways were based on a computer gravity model for the Great Falls Urban Transportation Network. All existing and committed roadway links were used with traffic volumes based on the most current population projections. It should be noted that in October of 1980, new census information became available. The Department of Transportation is currently reassessing the population growth patterns and assumptions used in preparing the Year 2000 population projections. Preliminary census figures indicate a decrease in population for the Great Falls area, and consequently, traffic assignments for the year 2000 used in this capacity analysis may be an overestimation of the future approach volumes. Therefore, caution should be exercised in the interpretation of the results.

For the special situation at the Third and Central intersection where modificaton to the intersection geometrics and signalization are eminent, the changes were incorporated in the Year 2000 analysis.

The results of the capacity analysis are summarized in Table No. 5. Each intersection approach was analyzed separately, and the A.D.T., Peak Hour Volume, Hourly Capacity and Service Volume are listed for each intersection approach based on both 1980 and Year 2000 traffic data.

C. INTERPRETATION OF STUDY RESULTS

The overall service level of any intersection is considered to be the service level of the worst intersection approach. Following are individual capacity analyses for the intersections studied.

Third Street NW and Central Avenue: This intersection presently operates at a very acceptable Level of Service B. This represents a stable flow of traffic with only minimal delays. The alterations that are planned for this intersection will effectively handle the anticipated increase in approach volumes. Improving the section of road between the First Avenue North Bridge and the Third and Central intersection should provide ample approach widths and lane storage, resulting in a Level of Service B for this intersection to the year 2000.

Third Street NW and Northwest Bypass: The Third and Bypass intersection functions very well at present with all approaches indicating Service Level A. Minor improvements to the median arrangement and pedestrian crosswalks have been recommended at this location. These improvements will upgrade the safety and flow characteristics at this location. The results of the capacity analysis show that there will be no capacity limitations occuring at this location in the year 2000.

Third Street NW and Smelter Avenue: This intersection is operating in a free flow condition at Service Level A. A large increase in the approach volume from the northwest on Smelter will occur by the year 2000. The data reflects the fact that a slight bottleneck will occur on this approach, although stable traffic operation will continue. Occasionally, drivers may have to wait through more than one red cycle. Delays on this approach will increase, but the overall intersection performance should remain within a tolerable Level of Service C.

Tenth Street and Smelter Avenue: This intersection is operating at the lowest level of service of any of the locations examined. The D/E Service Level is the result of the high volume of left-turning traffic approaching from the south. As discussed in Chapter V, several minor improvements could raise the present low level of service at this location to a stable flow condition (Service Level C). These improvements include: striping the south approach with two "left turn only" lanes; restriping the west leg exit lanes to provide a width of 18 feet; and installing additional loop detection equipment on all approaches.

TABLE NO. 5

CAPACITY ANALYSIS SUMMARY

		YEAR 1980				YEAR 2000			
Location	Approach Direction	ADT	Peak Hr. Volume	Hourly Capacity	Service Level	ADT	Peak Hr. Volume	Hourly Capacity	Service Level
Third St. NW & Central Ave.	North	3819	359	1107	A	7805	734	1538	A
	South	1266	119	800	A	4462	419	800	A
	East	9681	910	1448	B	11,099	1043	1497	B
	West	5543	521	1737	A	7507	706	1737	A
Third St. NW & Bypass	North	6372	599	1521	A	9854	926	1521	B
	South	4574	430	1440	A	6394	601	1440	A
	West	3468	326	1014	A	5626	529	1014	A
Third St. NW & Smelter Ave.	Southwest (on Third)	5426	510	1864	A	8494	798	1864	A
	Northeast (on Smelter)	10,149	954	2803	A	11,619	1092	2803	A
	Northwest (on Smelter)	1660	156	543	A	4507	424	543	C
Smelter Ave. & Tenth St. North	North	2149	202	1045	A	4682	440	1045	A
	South	10,404	978	1015	D/E	17,684	1662	1015	F
	East	2277	214	619	A	3083	290	619	A
	West	6830	642	3167	A	10,202	959	3167	A

The data indicates that without any improvements, this intersection will soon operate at a forced flow level (Service Level F). Even with the immediate improvements recommended above, this location will more than likely operate near a D/E service level in the year 2000. Additional modifications to the intersection that could be done in the future to relieve some of the congestion include: modifying the median on the south approach to facilitate the storage of left-turning vehicles and to provide three full approach lanes of considerable length; altering the lane use of the north approach to include two through lanes; and installing a multi-phase controller to handle the complicated phasing needs of the future traffic volumes. These long-range improvements are suggestions based on present population growth trends and future traffic projections. In the future when the intersection approaches capacity and the improvements are contemplated, a detailed intersection analysis should be conducted to better assess the impact of these recommendations on the conditions as they exist at that time.

RECOMMENDED IMPROVEMENTS

A. Introduction
B. Cost Estimates for Improvements
C. Cost Effectiveness of Proposed Improvements

CHAPTER X

RECOMMENDED IMPROVEMENTS

A. INTRODUCTION

The analyses that have been performed indicate that in general, the study corridor functions reasonably well. Most of the roadway is operating at an acceptable service level except for isolated capacity problems occuring at the intersection of Tenth and Smelter. Several problem areas were identified and discussed in the preceding chapters; however, these situations are for the most part very localized, requiring only minor modifications to the existing system.

The intent of the proposed improvements is to reduce accidents, minimize delays, improve nighttime roadway lighting, increase sight distances, and improve the flow characteristics through better channelization. The recommended improvements have been arranged in the order of probable implementation; however, the order of implementation is not critical since the improvements address unrelated problems, and the sequence of improvement can be altered to suit local priorities and funding. The immediate improvements listed in this section are needed at the present time and should be implemented as soon as priorities and funding allow. Long-range improvements are discussed in Section D of this chapter.

Descriptions of the recommended immediate improvements are as follows:

(1) Upgrade Intersection Lighting

The results of the lighting analysis indicate that the roadway lighting at the following intersections does not meet AASHTO illumination standards: Third and Central, Third and Bypass, Sixth and Smelter, Eighth and Smelter, and Tenth and Smelter. It is recommended that the intersection lighting in these areas be upgraded by installing additional luminaires.

(2) Add New Roadway Lighting System

The corridor section between the Bypass and the Sixth and Smelter intersection is presently unlighted. There are 42 curb cuts in this section which service two shopping centers, a variety of eating establishments, commercial and industrial sites. The nighttime accident rate of 12.8 acc/mvm in this area reflects the need for a roadway lighting system. It is recommended that a high-pressure sodium vapor lighting system be installed along this portion of the corridor.

(3) Install Additional Loop Detectors and Restripe Lanes at Tenth and Smelter

Both the signal system analysis and the capacity analysis reflect the problems vehicles have negotiating this intersection. A present service level of D/E (unstable flow) and capacity problems in the future indicate the need for modifications to the existing conditions. Additional loop detectors installed on all approaches will enable the signal controller to better assess the approach demand and corresponding phase timing needs. The additional detectors will increase the overall intersection

efficiency and reduce delays. Striping both the left and center lanes on the south approach and widening the west leg exit lanes will increase the intersection capacity and therefore raise the level of service at this intersection to a stable flow condition.

(4) Remove Excess Driveway Curb Cuts

The driveway curb cut inventory revealed that 21 out of the 94 existing accesses could be removed. The removal of these curb cuts will improve channelization and make midblock turning movements more predictable. It is recommended that a program of negotiation with the property owners involved be implemented to discuss removal of these excess accesses.

(5) Move Pedestrian Facilities at Third & Bypass

As stated in Chapter V, the pedestrian crosswalk on the north approach to the Third and Bypass intersection represents a possible hazardous situation. At present, pedestrians cross Third Street NW during the same signal phase that allows the Bypass traffic to pass through the intersection. This conflict can be alleviated by moving the pedestrian crosswalk and pedestrian signal facilities to the south approach. This proposed arrangement will increase the capacity of the west approach, improve the flow characteristics of the entire intersection, and provide a safer crossing for pedestrians.

(6) Reconstruct Raised Median at Third & Bypass

It is standard procedure to channelize and separate traffic at a major intersection such as this one. However, the existing arrangement of median islands on the north approach to the Third and Bypass intersection allows erratic turning movements to occur. The gap that exists between the medians originally served a railroad crossing that has since been eliminated. In an effort to control cross-traffic turning movements and U-turns in this area and thus improve the intersection geometrics, the existing medians should be modified and the space between them closed.

(7) Sign "No Parking" Areas

At present, on-street parking is not restricted along the corridor. This situation often results in a drastic reduction in sight distances at driveway exits and side streets. In the vicinity of any area that experiences large volumes of turning movements, on-street parking should be limited. The areas affected are delineated on Figure No. 12, and appropriate signing and curb striping should be installed at these locations.

(8) Improve Westgate Shopping Center Entrances

There are three driveway accesses to Westgate, one of which is located at the Third and Fourth Street intersection. This intersection has the highest accident rate (1.9 acc/mve) of all the

intersections studied, and this high rate can be chiefly attributed to the presence of the shopping center entrance. The other entrances also present potentially hazardous situations due to the lack of proper alignment and poor entrance delineation. It is recommended that the eastbound corridor approach to the Third and Fourth intersection be marked to provide a right-turn bay for the shopping center traffic. All three entrances should be widened and a new curb arrangement installed to promote the proper intersection approach alignment. Stop signs and pavement lane markings should also be installed at each exit.

(9) Install New Sidewalk From Seventeenth to Sixth

At present, the southwest side of the corridor between Seventeenth Street and Sixth Street has no pedestrian facilities. The pedestrian and bicyclist study revealed that many shopping center patrons living in the northwest residential area walk or ride bicycles to the Westgate Shopping Center, primarily travelling along the southwest side of the corridor. It is recommended that a sidewalk be installed in this area to service the pedestrian traffic.

(10) New Intersection Lane Use Signs

All of the signalized intersections within the corridor have unique turning movement needs. Three of the four intersections have parallel turning lanes which require more efficient motorist guidance. It is recommended that lane use signs be installed on the approaches to these major intersections in order to improve the operational efficiency, reduce delays and minimize confusion.

(11) Sign and Mark Pedestrian Crosswalks at Fourth & Sixth Streets, and Remove Existing Pedestrian Signal Heads at Third & Smelter

Two locations with pedestrian traffic were identified during the pedestrian and bicyclist study. The origin of this pedestrian traffic appears to be the residential area to the northwest, and the destination is the Westgate Shopping Center. The majority of the pedestrians cross at the Fourth Street intersection and in the vicinity of Sixth and Smelter. The existing pedestrian signal located at Third and Central is not used and does not appear to be necessary; therefore, it is recommended that this signal head be removed and crosswalks be marked and appropriately signed at Third and Fourth and Sixth and Smelter.

(12) Install Pin-Down Curbs at J - T Ranch House

The section of the corridor adjacent to the J - T Ranch House has the highest nighttime accident rate (6.1 acc/mve) of any area within the study limits. The four existing driveway accesses that currently service this establishment appear to create an unpredictable turning movement situation, and it is recommended that two of these curb cuts be closed. It has been observed that patrons

exit at all points of the road frontage without regard to driveways or the existing curbs. To further channelize the entrance and exit maneuvers, it is recommended that pin-down curbs be installed on the parking lot pavement behind the existing curb and gutter. This method of access control will make circulation in the J - T area more predictable, and therefore minimize conflicts and reduce accidents.

(13) Alter Internal Circulation Pattern at McDonalds

As discussed in Chapter VII, the internal circulation pattern of McDonalds creates a particularly hazardous situation. It is recommended that McDonalds alter their parking area and entrance signing as shown on Figure No. 12-E. Costs for this improvement have not been included in this report since the improvements will be made on private property at McDonalds' expense.

B. COST ESTIMATES FOR IMPROVEMENTS

Each improvement was examined individually and all major construction items identified. Unit bid prices based on recent statewide bid tabulations provided by the Department of Highways were used to estimate construction costs. Miscellaneous bid items not specifically mentioned in the estimate are accounted for by a ten percent "contingency" item. Engineering and administrative expenses were estimated to be twenty percent of the total construction cost, and are listed as a separate item. The total project estimate is a combination of the construction costs, contingencies and engineering expenses. The improvements and their corresponding costs are displayed in Table No. 6. A detailed breakdown of the major construction costs and unit prices can be found in Appendix E, "Cost Estimate Summary".

C. COST EFFECTIVENESS OF PROPOSED IMPROVEMENTS

A benefit/cost analysis was performed for each improvement item. The construction and maintenance costs were derived from state averages and amortized over the estimated service life of the improvements at an annual interest rate of eight percent. The annual benefits were calculated on the basis of standard accident reduction rates provided by the Department of Highways. In the case of pedestrian facilities, a safety and convenience factor of $.10 per user was applied to arrive at an appropriate benefit. The annual costs and benefits for each improvement and the corresponding benefit/cost ratio are listed in Table No. 7. The actual benefit/cost analysis calculations are on file with the Planning and Research Bureau of the Department of Highways.

D. LONG-RANGE IMPROVEMENTS

Several long-range improvements have been identified in this report. Roadway lighting improvements mentioned in Chapter IV included an extension of the corridor lighting system along the Smelter Avenue portion of the study route. This improvement is expected to be necessary in the late 1990's or when sufficient development in this area occurs to justify the lighting system.

In Chapter V, several long-range traffic signal improvements were discussed. With increased development and traffic growth, the corridor will eventually require a signal control system. The best locations for future signalized intersections to optimize the operation of a signal control system have been previously identified and discussed in Chapter V. Based on current growth trends, a signal interconnect system and modifications to the existing signal locations will be necessary in the early 1990's.

TABLE NO. 6

IMPROVEMENT COST ESTIMATES

Improvement	Costs			
	Construction	Contingency	Engineering	Total
I. IMMEDIATE IMPROVEMENTS				
1. Upgrade Intersection Lighting	$21,449	$2,145	$4,290	$27,884
2. Install New Roadway Lighting System	81,083	8,108	16,217	105,408
3. Install Additional Loop Detectors and Restripe Lanes at Tenth & Smelter	7,025	702	1,405	9,130
4. Remove Excess Driveway Curb Cuts	9,555	956	1,911	12,422
5. Move Pedestrian Facilities at Third & Bypass	2,456	246	491	3,193
6. Reconstruct Raised Median at Third & Bypass	2,850	285	570	3,705
7. Sign "No Parking" Areas	9,647	965	1,929	12,541
8. Improve Westgate Entrances	9,639	964	1,928	12,531
9. Install New Sidewalk from Seventeenth Street to Sixth Street	19,878	1,988	3,976	25,842
10. Install New Intersection Lane Use Signs	16,998	1,700	3,400	22,098
11. Sign and Mark Pedestrian Crosswalk at Fourth Street and Sixth Street, and Remove Pedestrian Signals at Third & Smelter	7,022	702	1,404	9,128
12. Install Pin Down Curbs at J - T	3,200	320	640	4,160
TOTAL:	$190,802	$19,080	$38,160	$248,042

TABLE NO. 6
(cont.)

Improvement	Costs			
	Construction	Contingency	Engineering	Total
II. LONG-RANGE IMPROVEMENTS				
1. Extend Corridor Lighting System from Sixth & Smelter to Tenth & Smelter (16 lights)	$64,000	$6,400	$12,800	$83,200
2. Signalize Fourteenth Avenue Intersection	46,000	4,600	9,200	59,800
3. Signalize the Fourth Street and Sixth Street Intersections and Remove Traffic Signal at the Third & Smelter Intersection	95,000	9,500	19,000	123,500
4. Implement a Traffic-Adjusted Signal Control System on the Corridor From the Third & Bypass Intersection to the Tenth & Smelter Intersection	135,000	13,500	27,000	175,500
TOTAL:	$340,000	$34,000	$68,000	$442,000

TABLE NO. 7

BENEFIT/COST ANALYSIS SUMMARY

Improvement	Total Cost	Annual Cost	Annual Benefit	Benefit/Cost
1. Upgrade Intersection Lighting	$ 27,884	$ 3,558	$19,800	5.47
2. Install New Roadway Lighting System	105,408	12,315	18,630	1.51
3. Install Additional Loop Detectors and Restripe Lanes at Tenth & Smelter	9,130	1,761	5,024	2.85
4. Remove Excess Driveway Curb Cuts	12,422	1,265	2,415	1.91
5. Move Pedestrian Facilities at Third & Bypass	3,193	800	881	1.10
6. Reconstruct Raised Median at Third & Bypass	3,705	377	435	1.15
7. Sign "No Parking" Areas	12,541	3,063	4,049	1.32
8. Improve Westgate Entrances	12,531	1,476	4,928	3.34
9. Install New Sidewalk from Seventeenth Street to Sixth Street	25,842	3,032	4,453	1.47
10. Install New Intersection Lane Use Signs	22,098	3,693	3,878	1.05
11. Sign and Mark Pedestrian Crosswalks at Fourth Street & Sixth Street, and Remove Pedestrian Signals at Third & Smelter	9,128	4,606	5,336	1.16
12. Install Pin-Down Curbs at J - T	4,160	720	1,242	1.73
TOTAL COST OF IMPROVEMENTS:	$248,042			

Benefit/Cost Analyses for the long-range improvements have not been included in this table due to future uncertainties concerning costs, benefits, and methods of computation.

PHOTOGRAPHIC VIEW OF RECOMMENDED IMPROVEMENT PLAN

LEGEND

BUSINESS NAME
(with number of available off-street parking spaces)

MATCH LINE

RIGHT-OF-WAY

CURB

DRIVEWAY ACCESS

DRIVEWAY ACCESS
(To Be Removed)

PAINTED MEDIAN

RAISED MEDIAN

RAISED MEDIAN
(Proposed)

SIDEWALK
(Proposed)

CROSSWALK

STREET LIGHT
(Existing)

STREET LIGHT
(Proposed)

SIGNING
(Existing)

SIGNING
(Proposed)

TRAFFIC SIGNALS

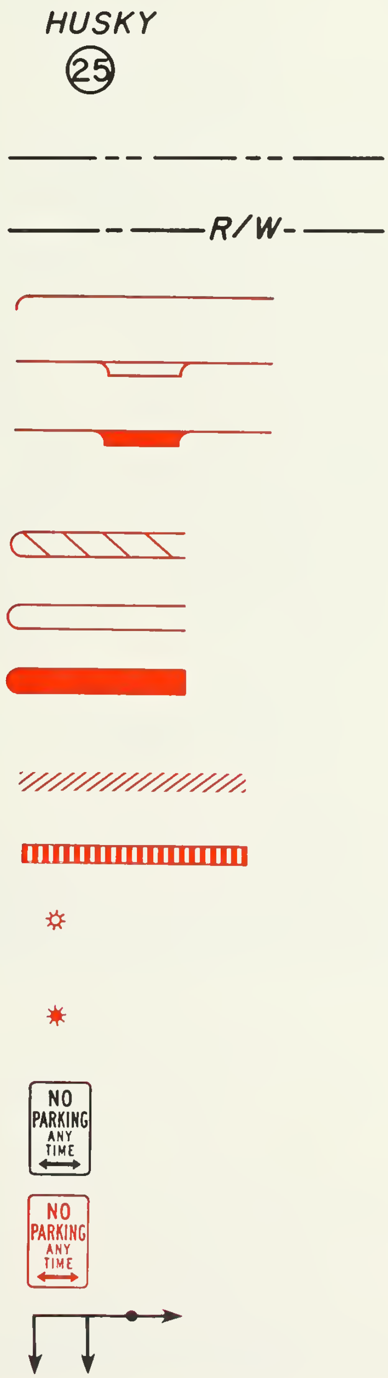
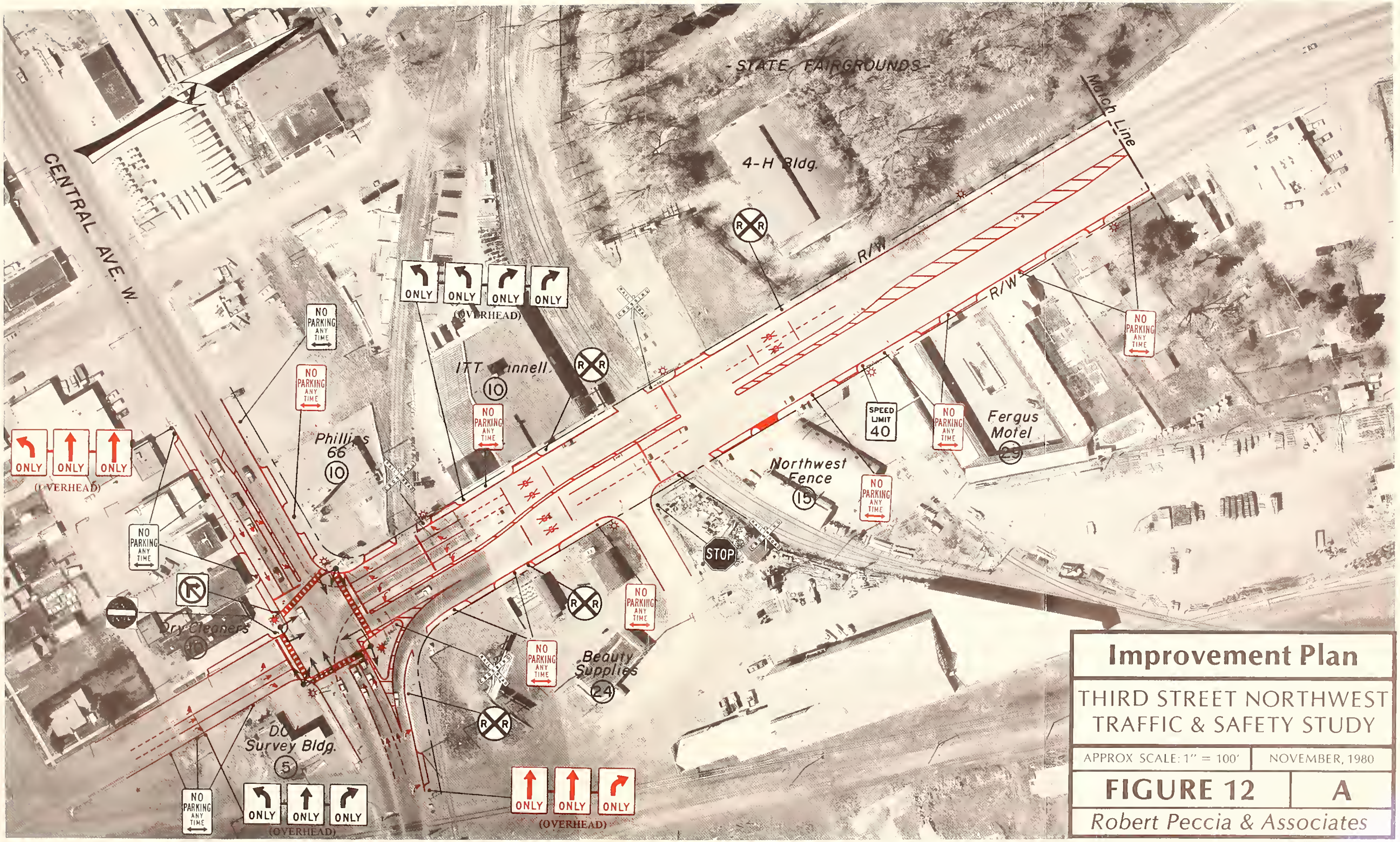


FIGURE 12

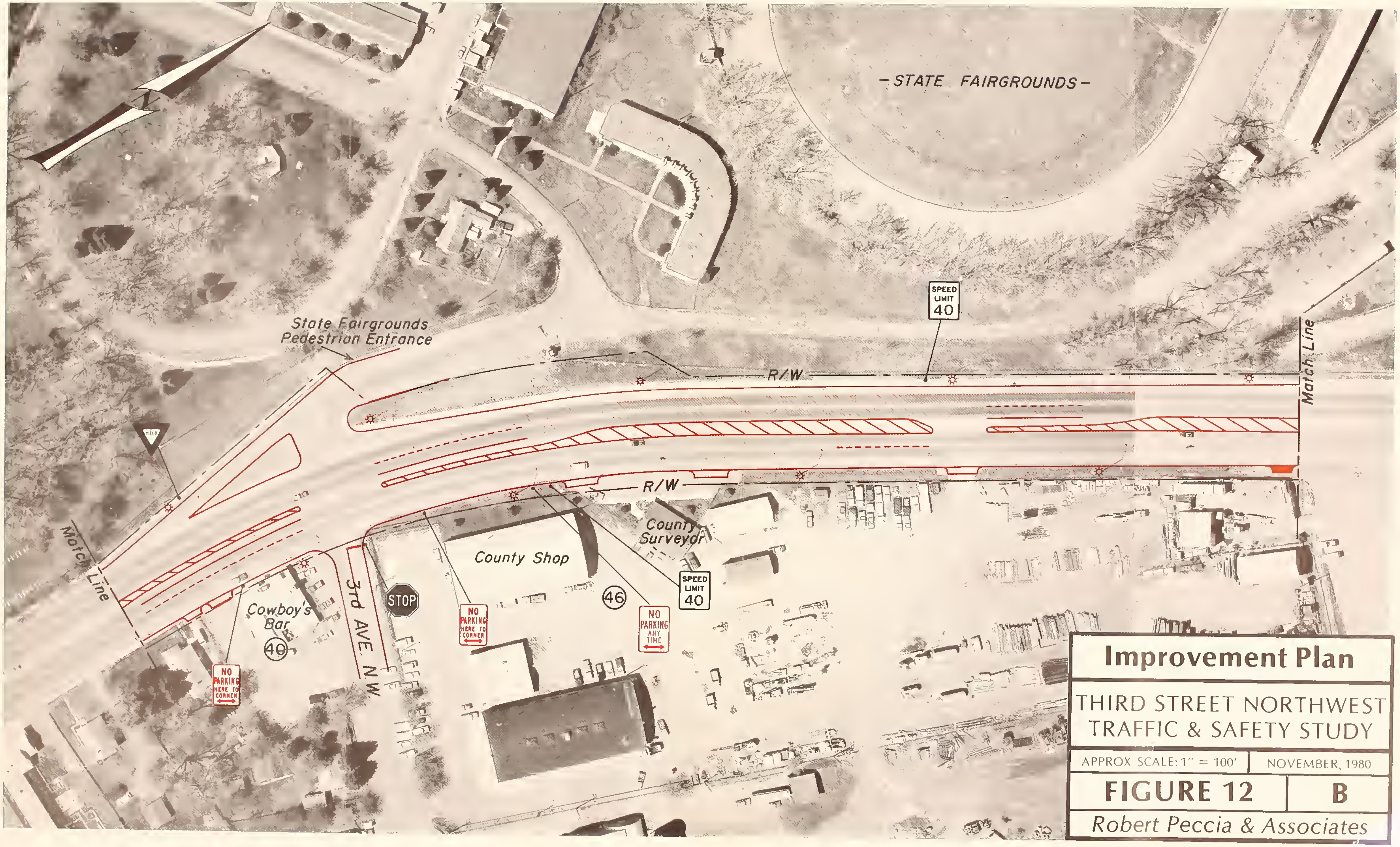


Improvement Plan

THIRD STREET NORTHWEST
TRAFFIC & SAFETY STUDY

APPROX SCALE: 1" = 100'	NOVEMBER, 1980
FIGURE 12	**A**

Robert Peccia & Associates



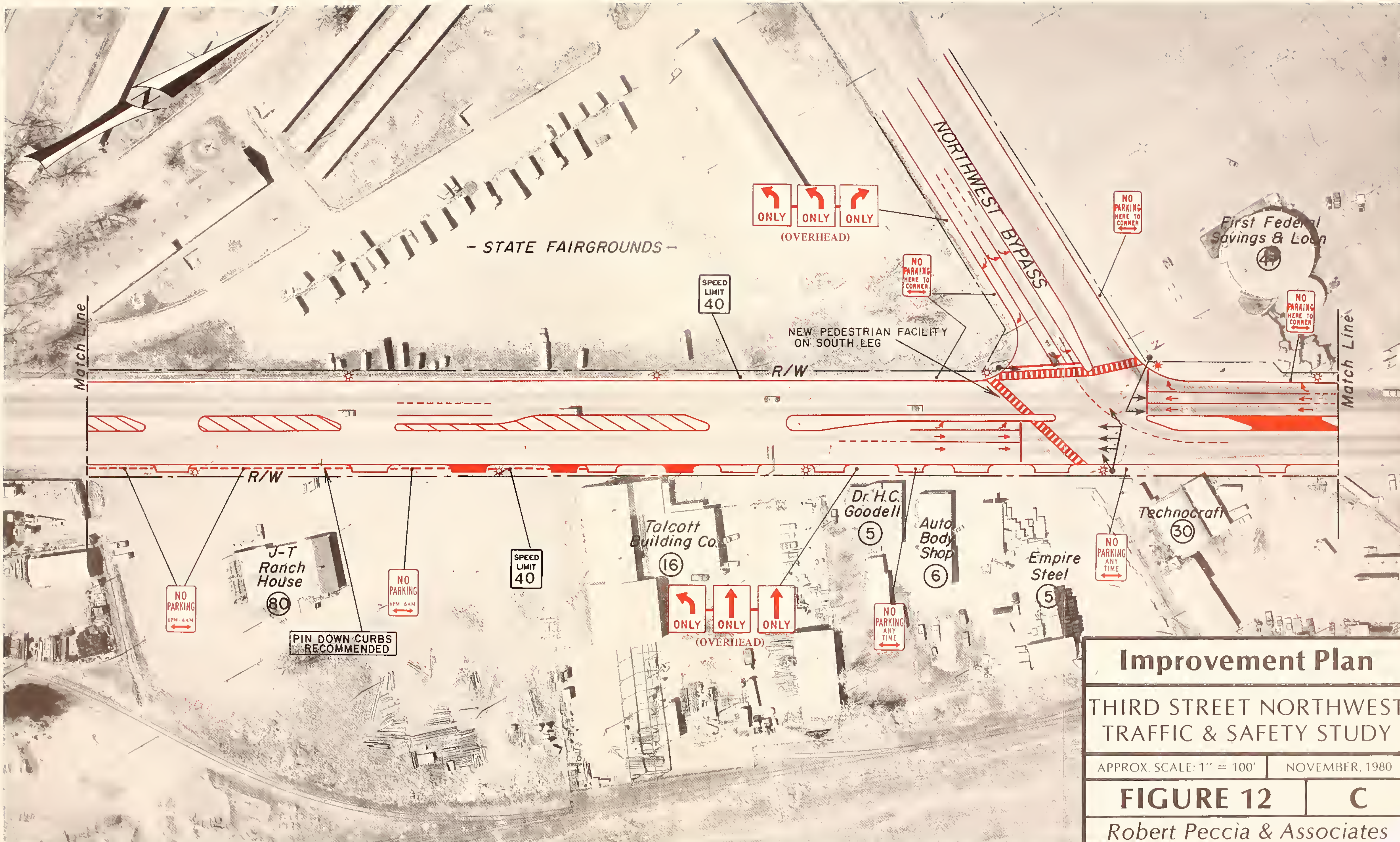
Improvement Plan

THIRD STREET NORTHWEST
TRAFFIC & SAFETY STUDY

APPROX SCALE: 1″ = 100′ | NOVEMBER, 1980

FIGURE 12 **B**

Robert Peccia & Associates



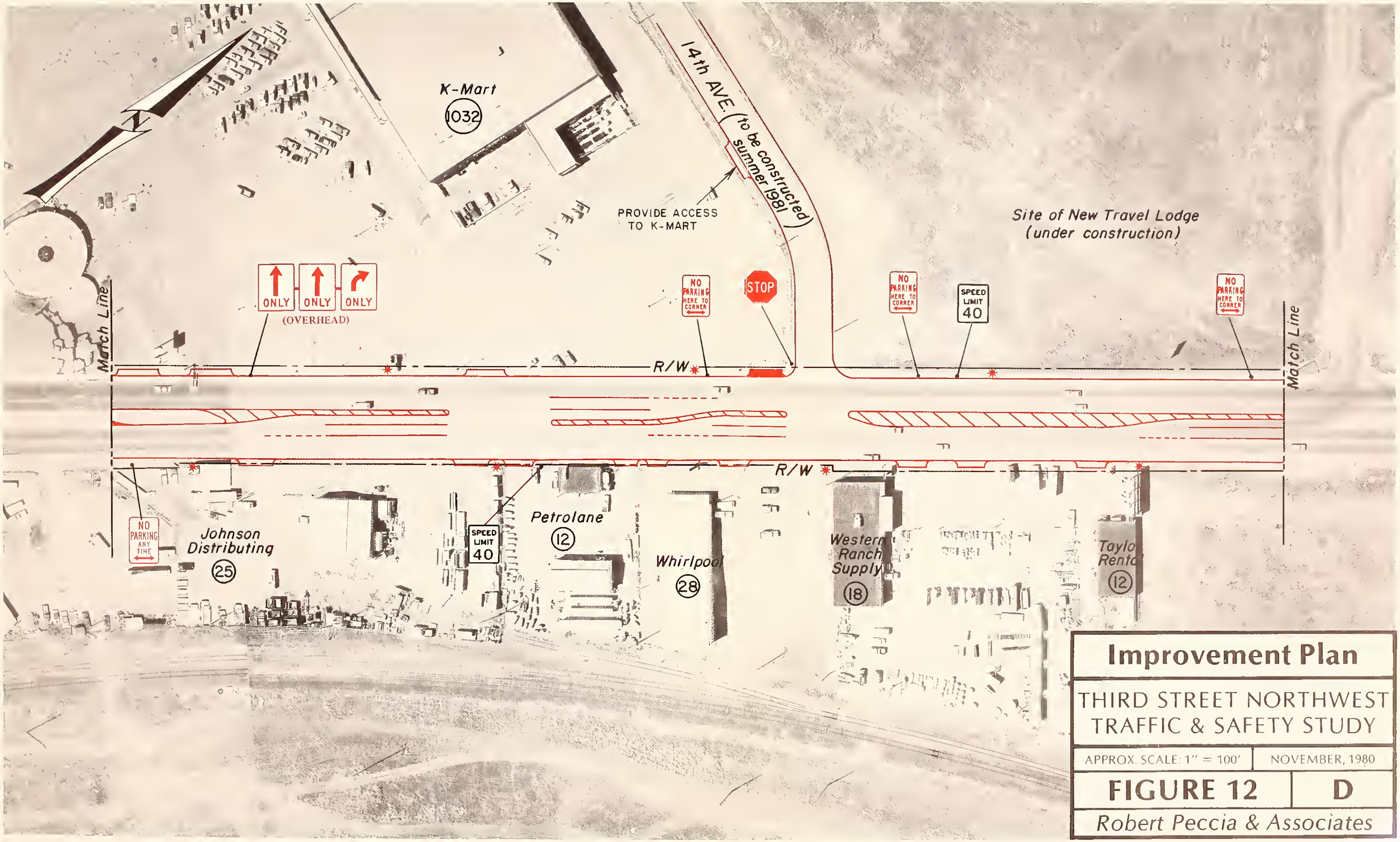
Improvement Plan

THIRD STREET NORTHWEST
TRAFFIC & SAFETY STUDY

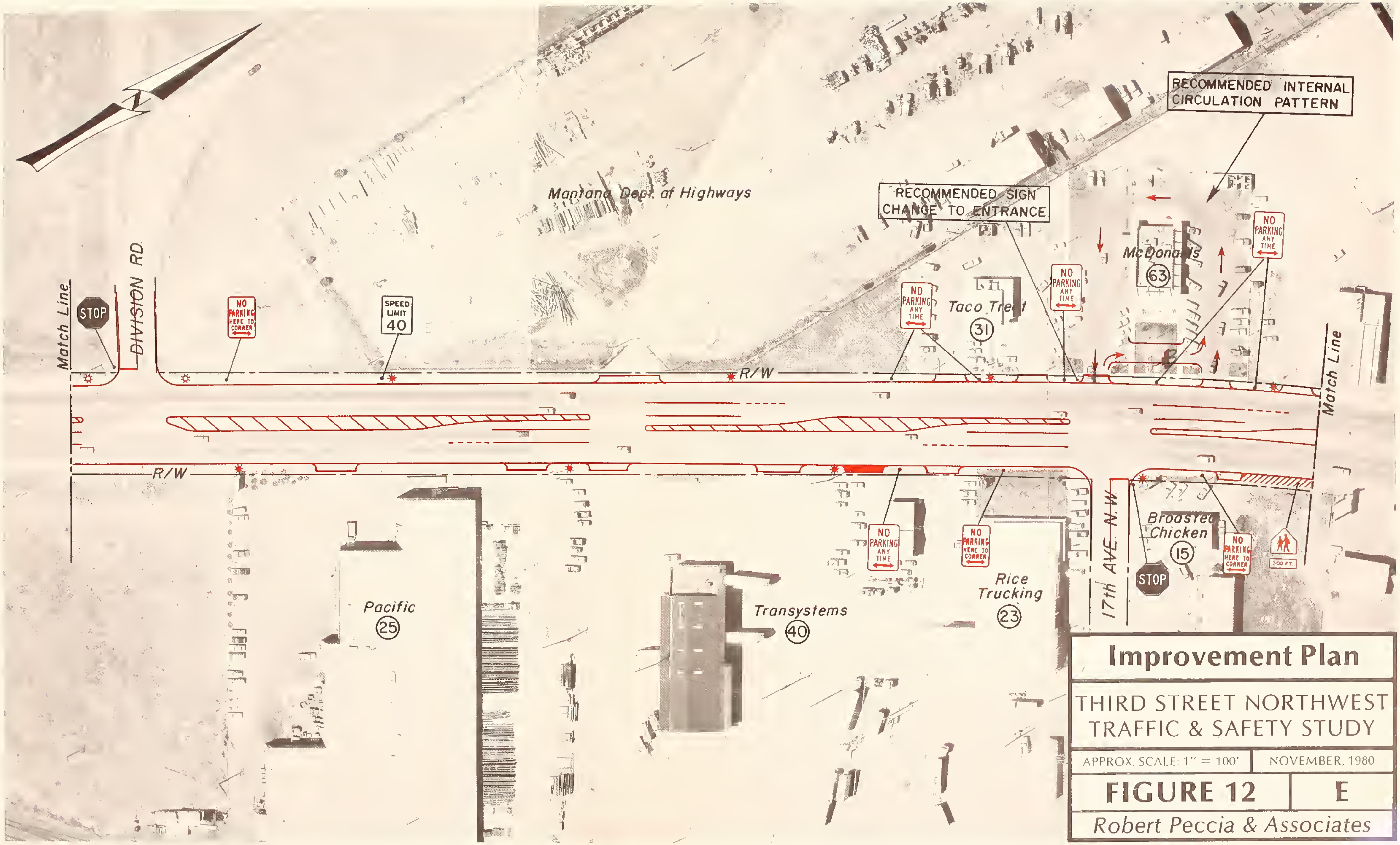
APPROX. SCALE: 1" = 100' | NOVEMBER, 1980

FIGURE 12 | **C**

Robert Peccia & Associates



Improvement Plan	
THIRD STREET NORTHWEST TRAFFIC & SAFETY STUDY	
APPROX. SCALE: 1" = 100'	NOVEMBER, 1980
FIGURE 12	D
Robert Peccia & Associates	



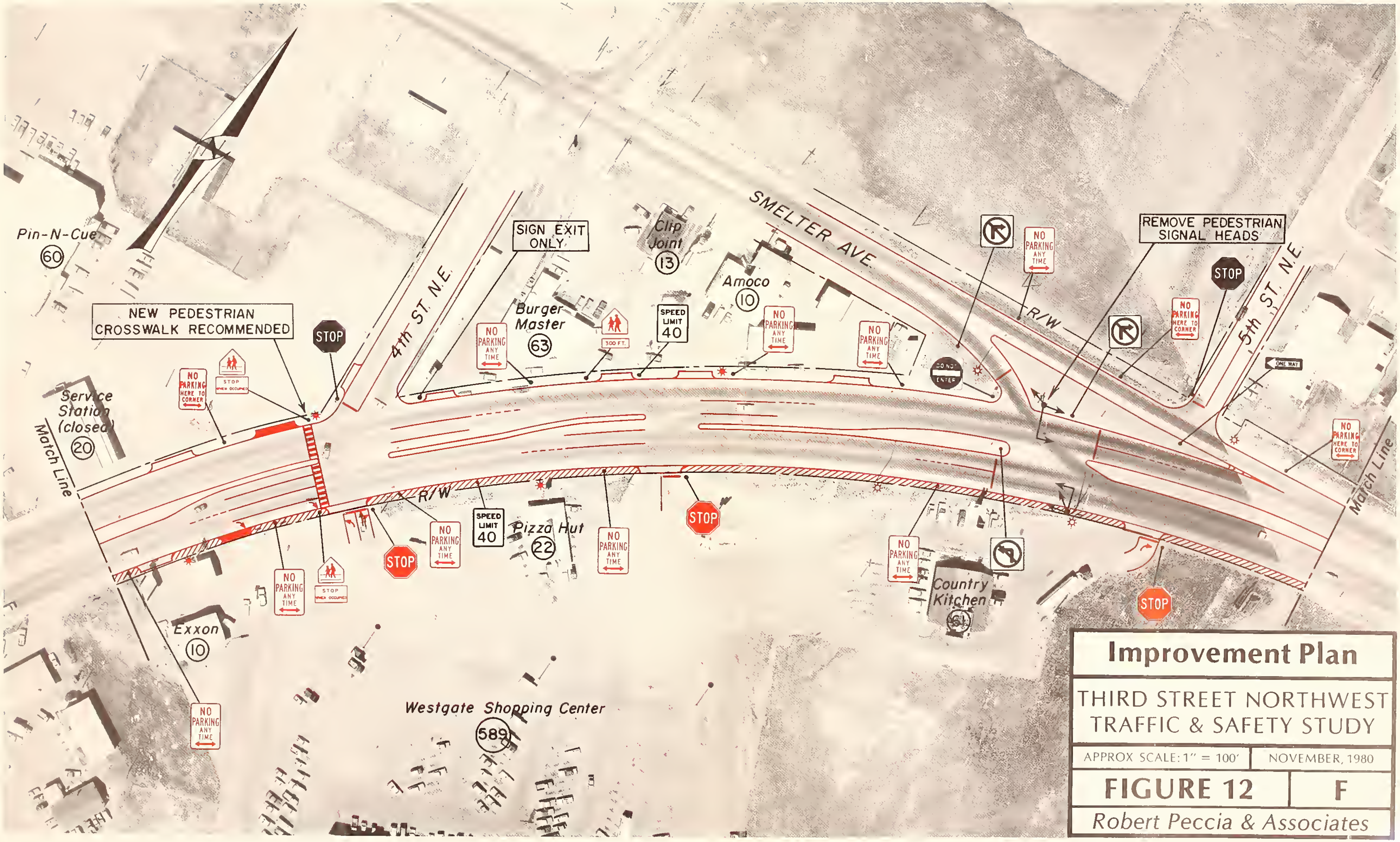
Improvement Plan

THIRD STREET NORTHWEST
TRAFFIC & SAFETY STUDY

APPROX. SCALE: 1" = 100' | NOVEMBER, 1980

FIGURE 12 | **E**

Robert Peccia & Associates



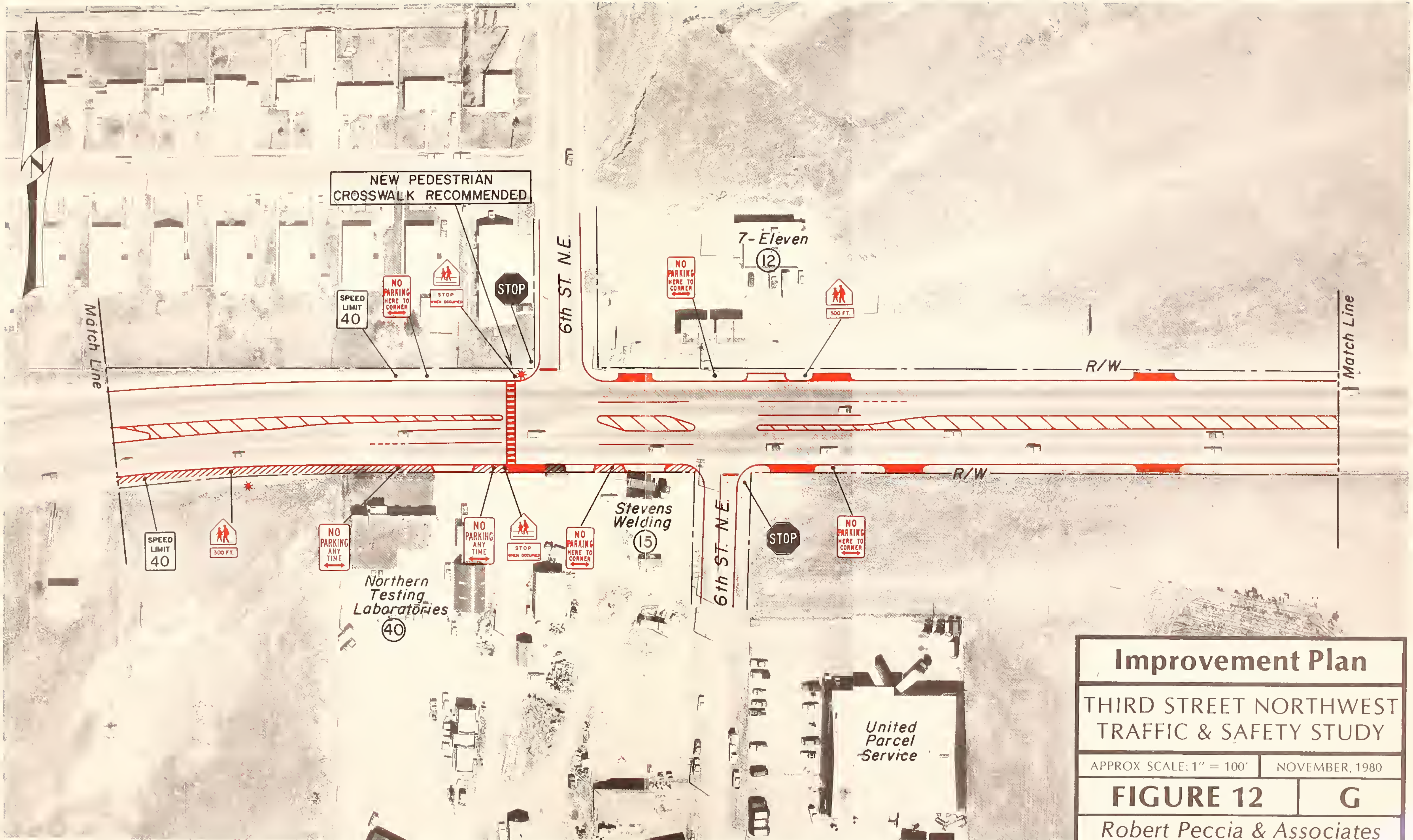
Improvement Plan

THIRD STREET NORTHWEST TRAFFIC & SAFETY STUDY

APPROX SCALE: 1" = 100' | NOVEMBER, 1980

FIGURE 12 | F

Robert Peccia & Associates



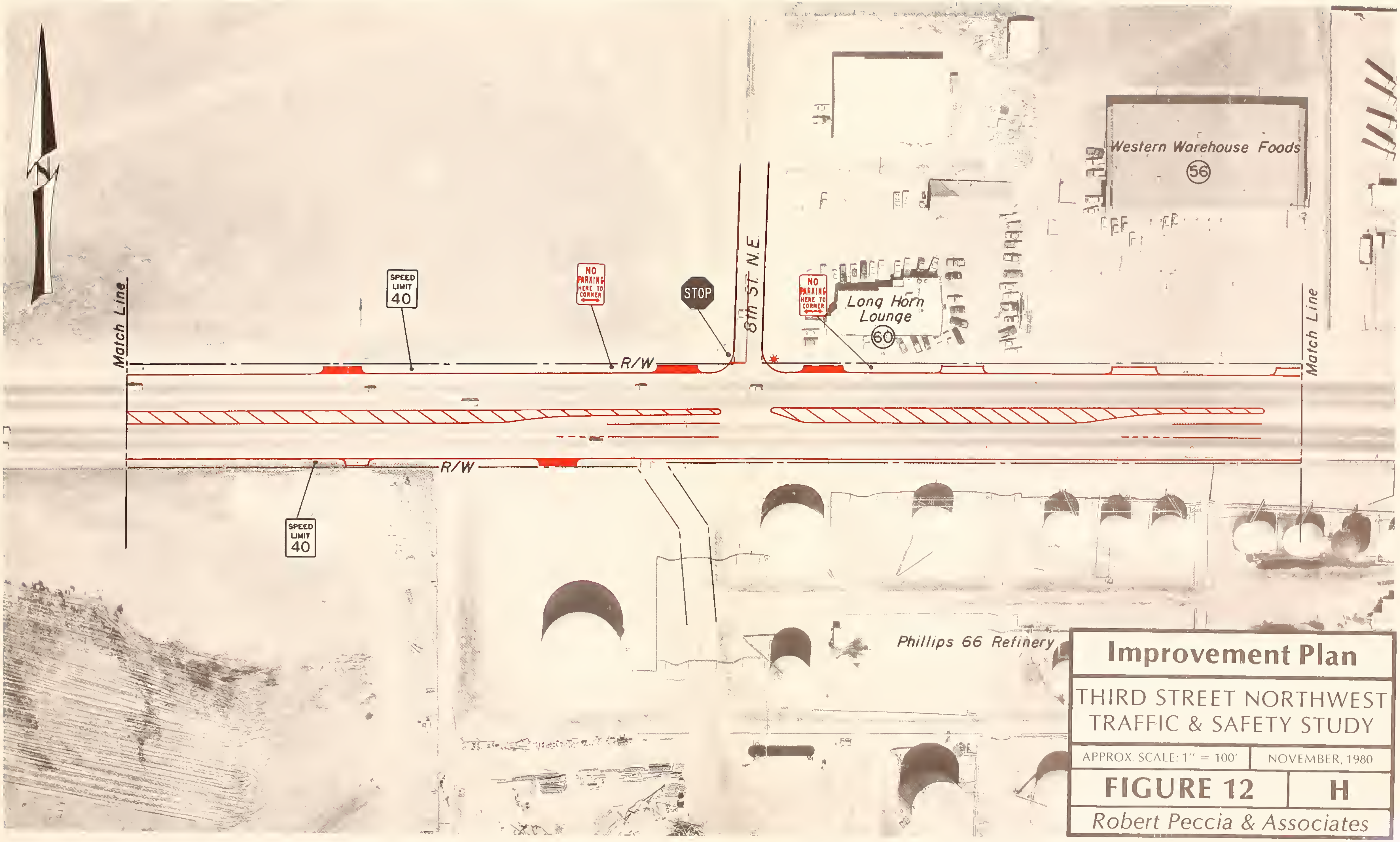
Improvement Plan

THIRD STREET NORTHWEST TRAFFIC & SAFETY STUDY

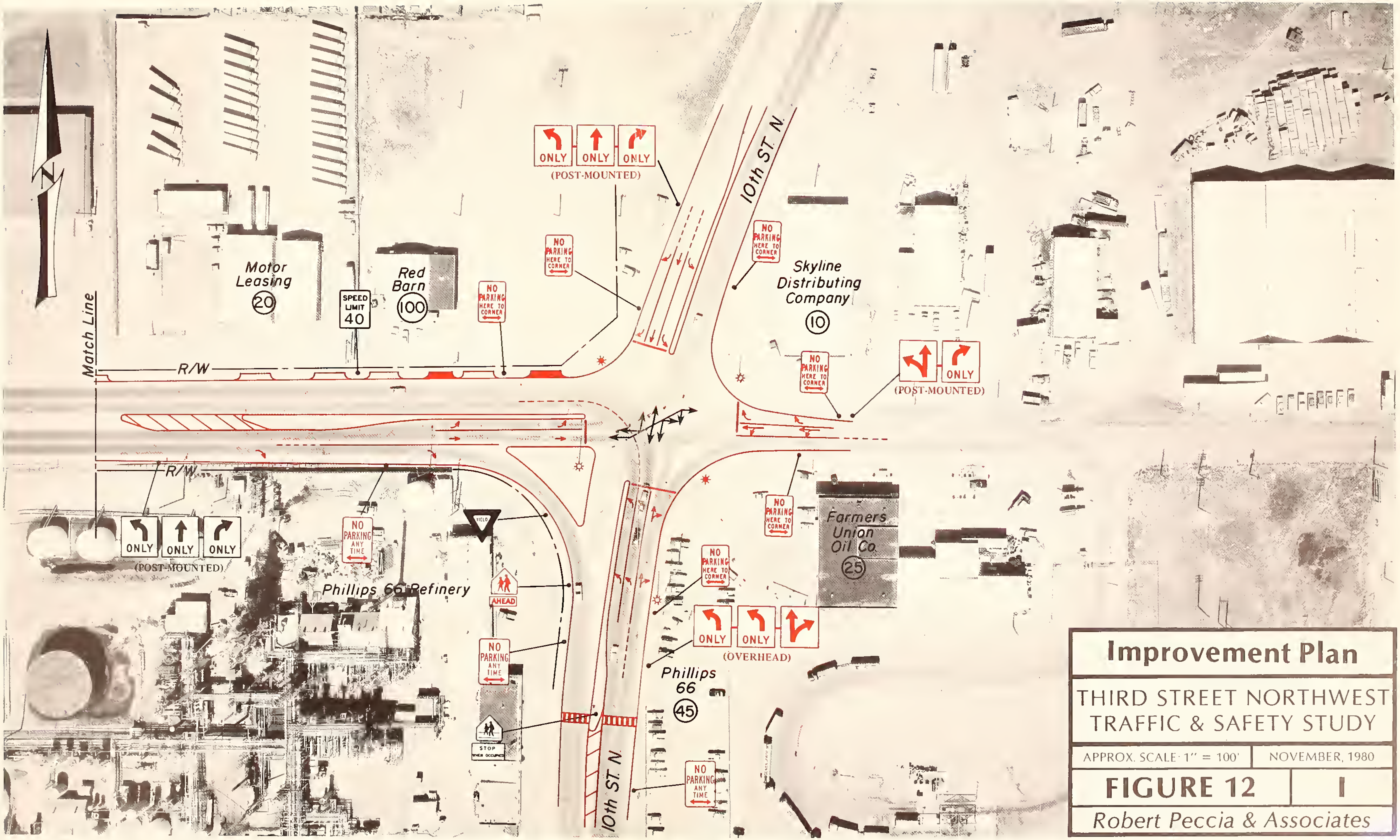
APPROX SCALE: 1″ = 100′ | NOVEMBER, 1980

FIGURE 12 | **G**

Robert Peccia & Associates



Improvement Plan
THIRD STREET NORTHWEST TRAFFIC & SAFETY STUDY
APPROX. SCALE: 1″ = 100′
NOVEMBER, 1980
FIGURE 12 H
Robert Peccia & Associates



Improvement Plan

THIRD STREET NORTHWEST TRAFFIC & SAFETY STUDY

APPROX. SCALE 1" = 100' | NOVEMBER, 1980

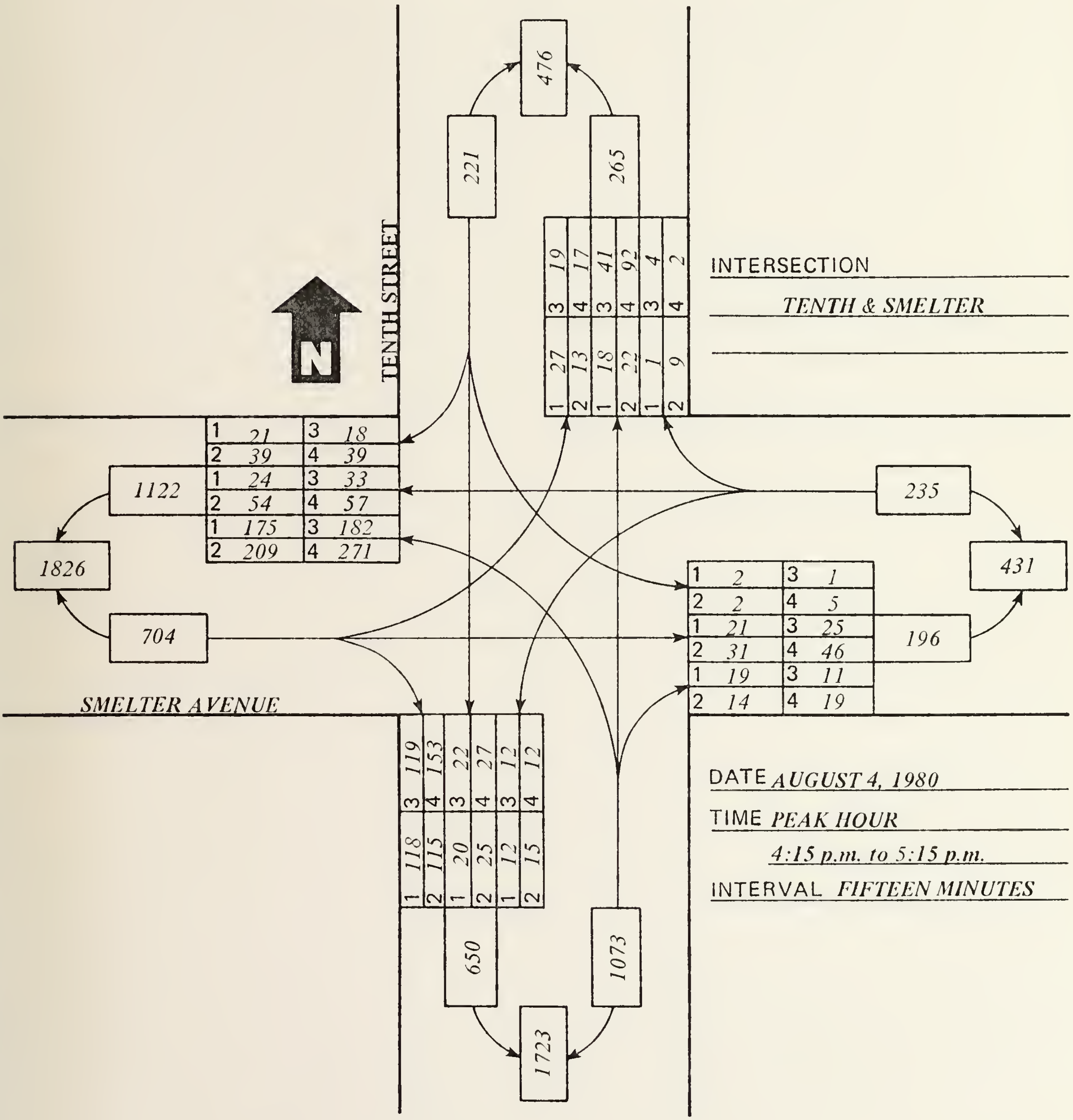
FIGURE 12 | 1

Robert Peccia & Associates

APPENDIX A
Peak Hour Turning Movements

Turning movement counts were taken at nine major intersections along the study corridor. Each intersection was counted for two hours during the three peak periods of the same day. The raw data contained in this appendix represents the turning movements that occured during the peak hour on the test day. These volumes have not been factored.

TURNING MOVEMENTS



INTERSECTION

TENTH & SMELTER

DATE *AUGUST 4, 1980*

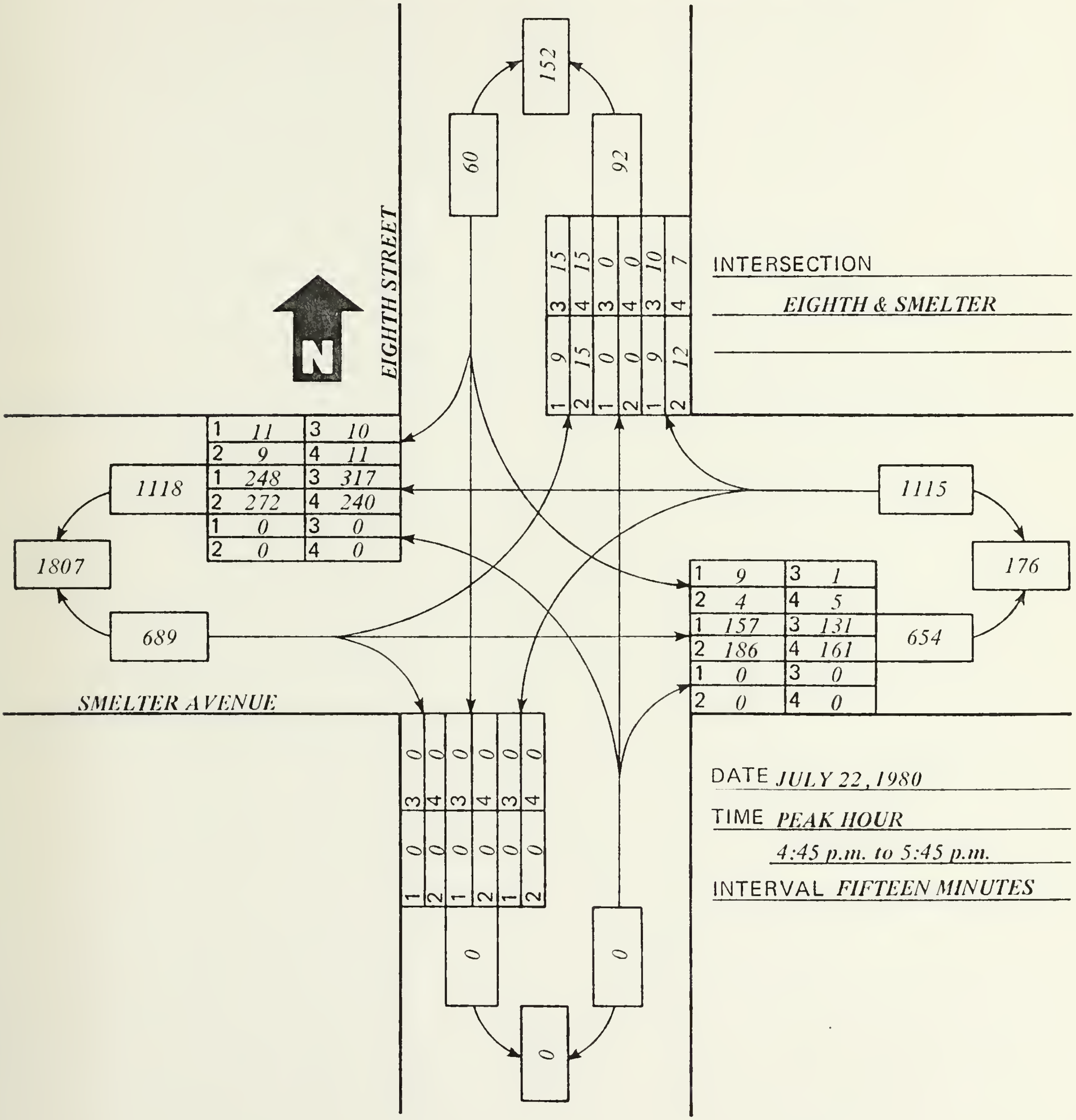
TIME *PEAK HOUR*

4:15 p.m. to 5:15 p.m.

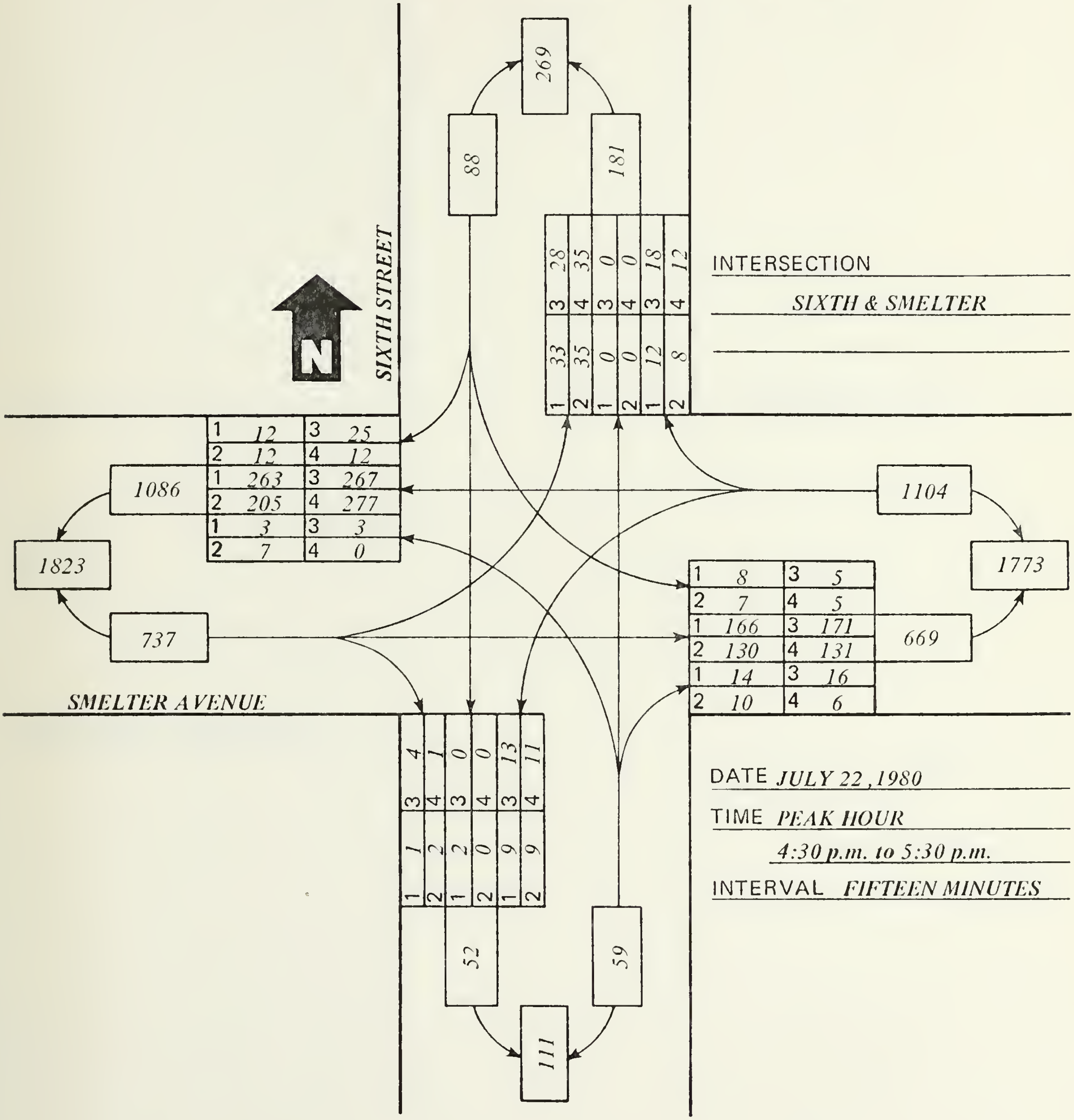
INTERVAL *FIFTEEN MINUTES*

RPA Robert Peccia & Associates

TURNING MOVEMENTS



TURNING MOVEMENTS



INTERSECTION
SIXTH & SMELTER

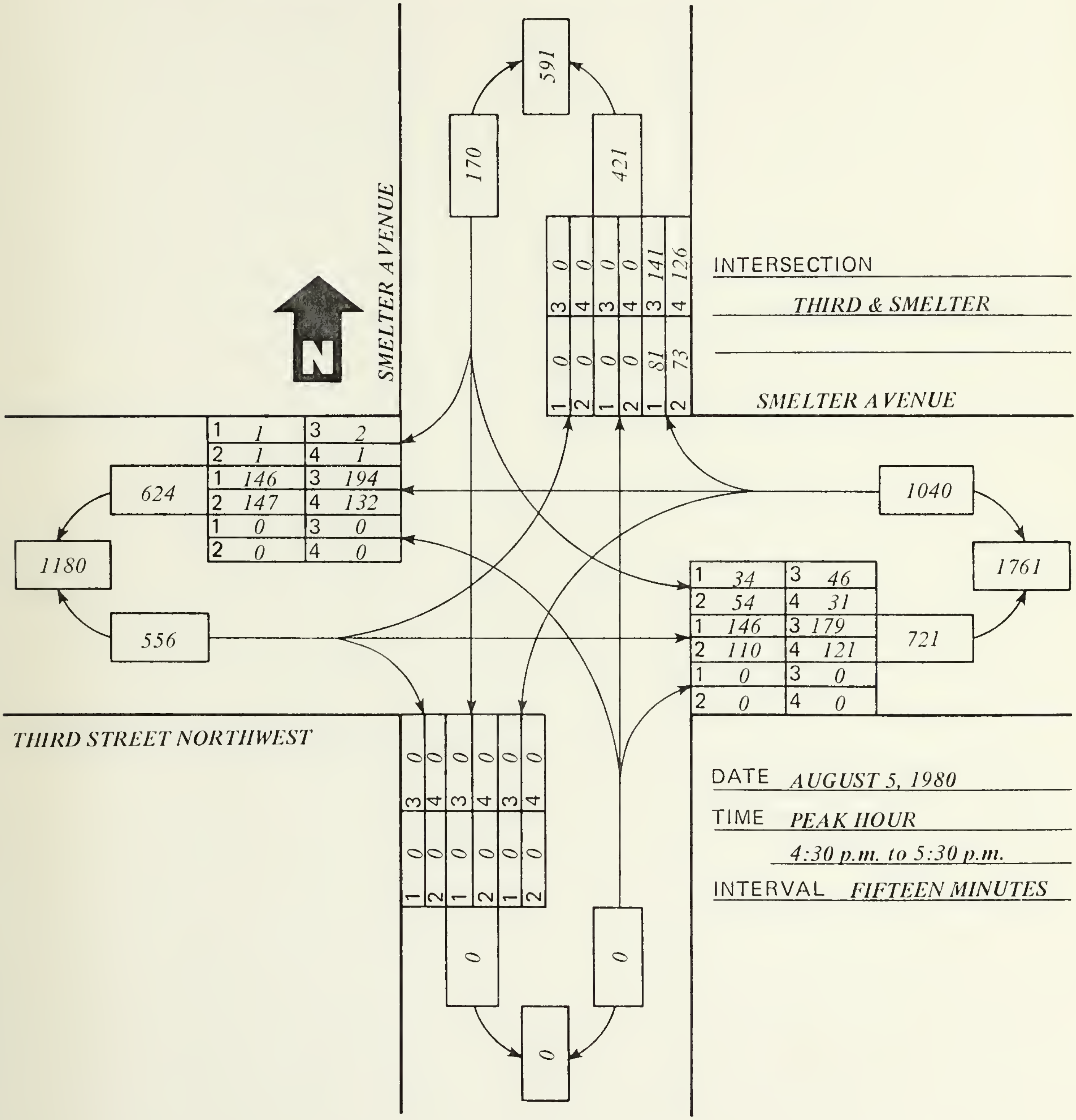
DATE *JULY 22, 1980*

TIME *PEAK HOUR*
4:30 p.m. to 5:30 p.m.

INTERVAL *FIFTEEN MINUTES*

RPA Robert Peccia & Associates

TURNING MOVEMENTS



INTERSECTION *THIRD & SMELTER*

SMELTER AVENUE

DATE *AUGUST 5, 1980*

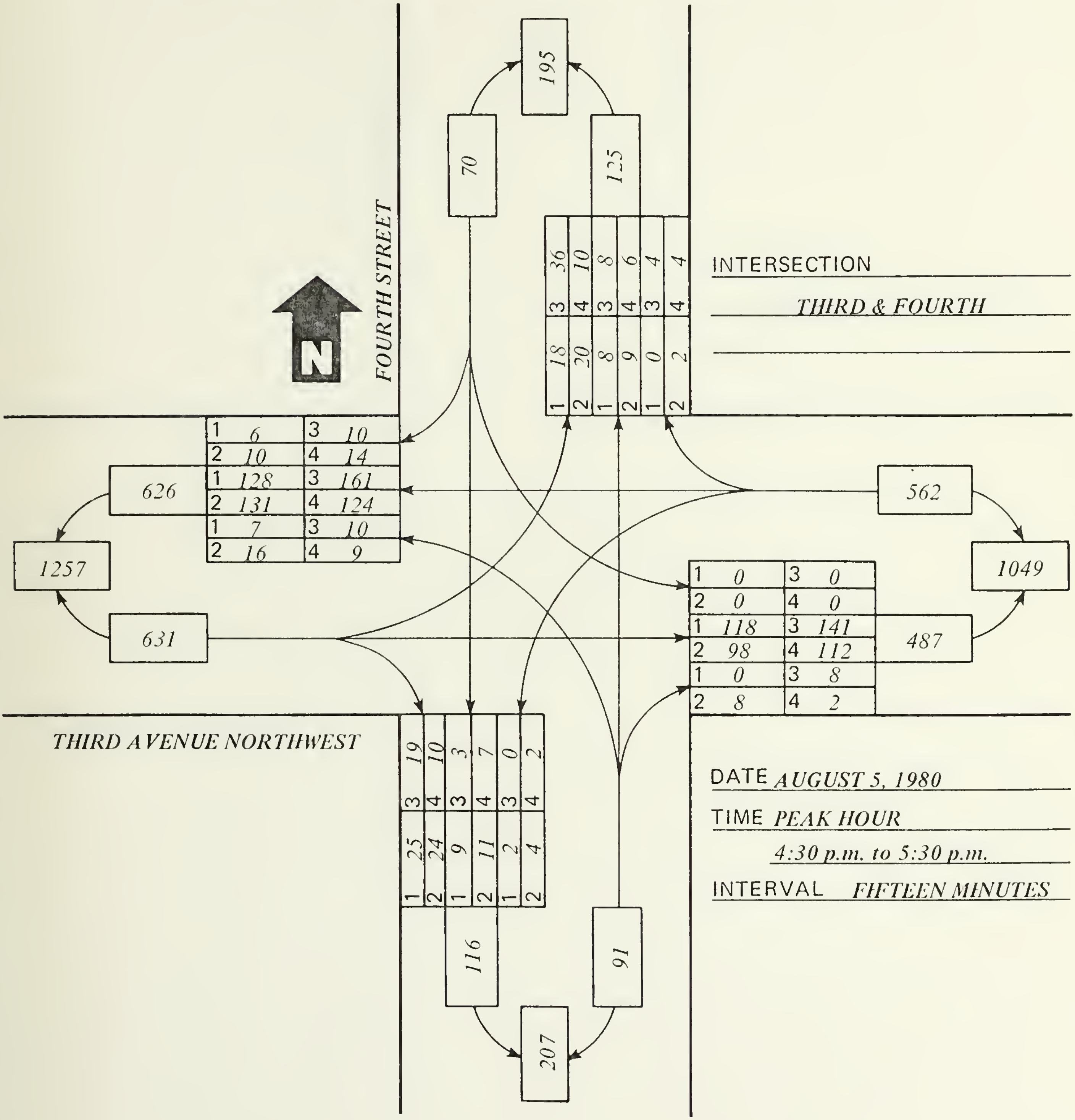
TIME *PEAK HOUR*

4:30 p.m. to 5:30 p.m.

INTERVAL *FIFTEEN MINUTES*

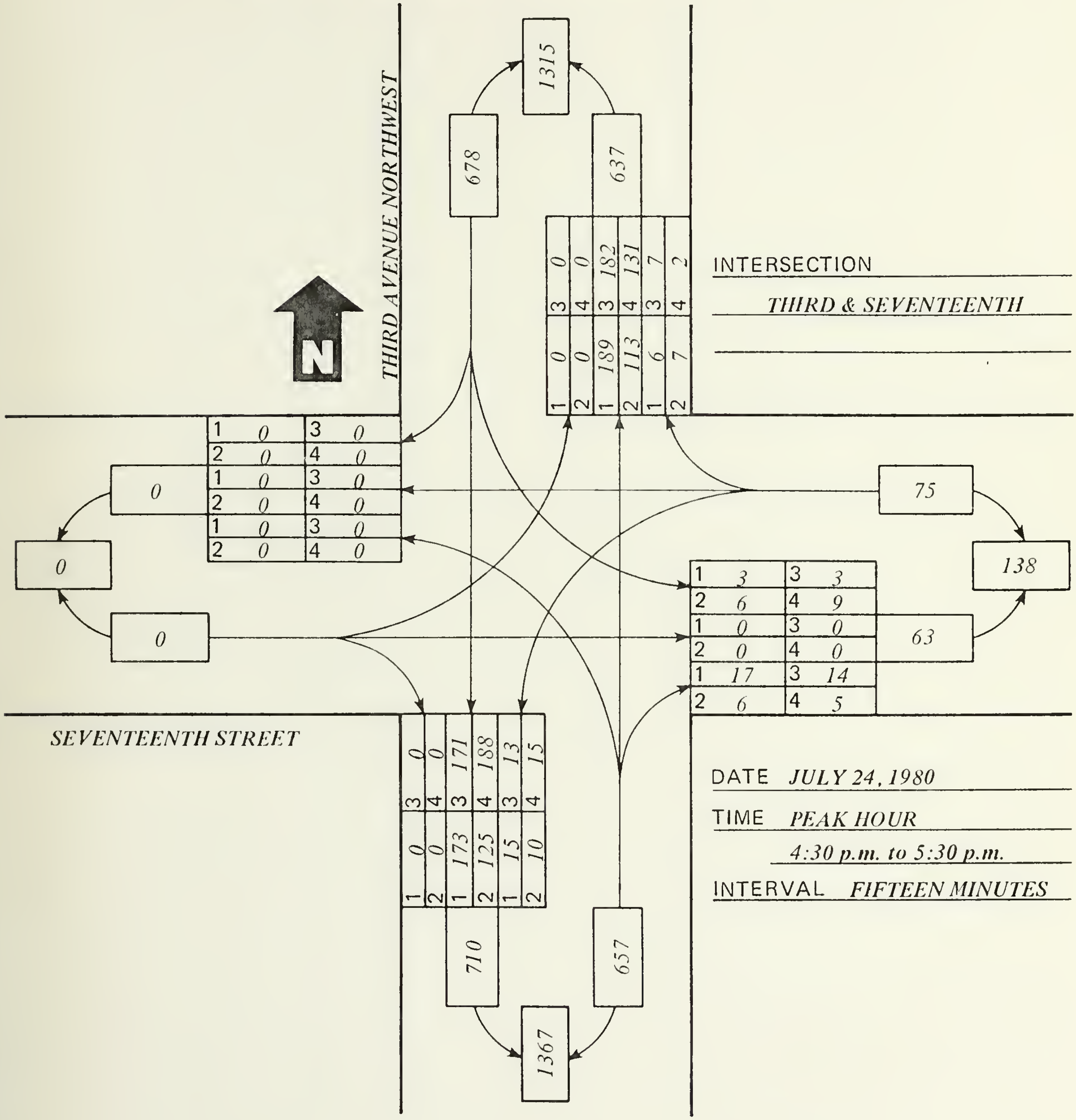
Robert Peccia & Associates

TURNING MOVEMENTS



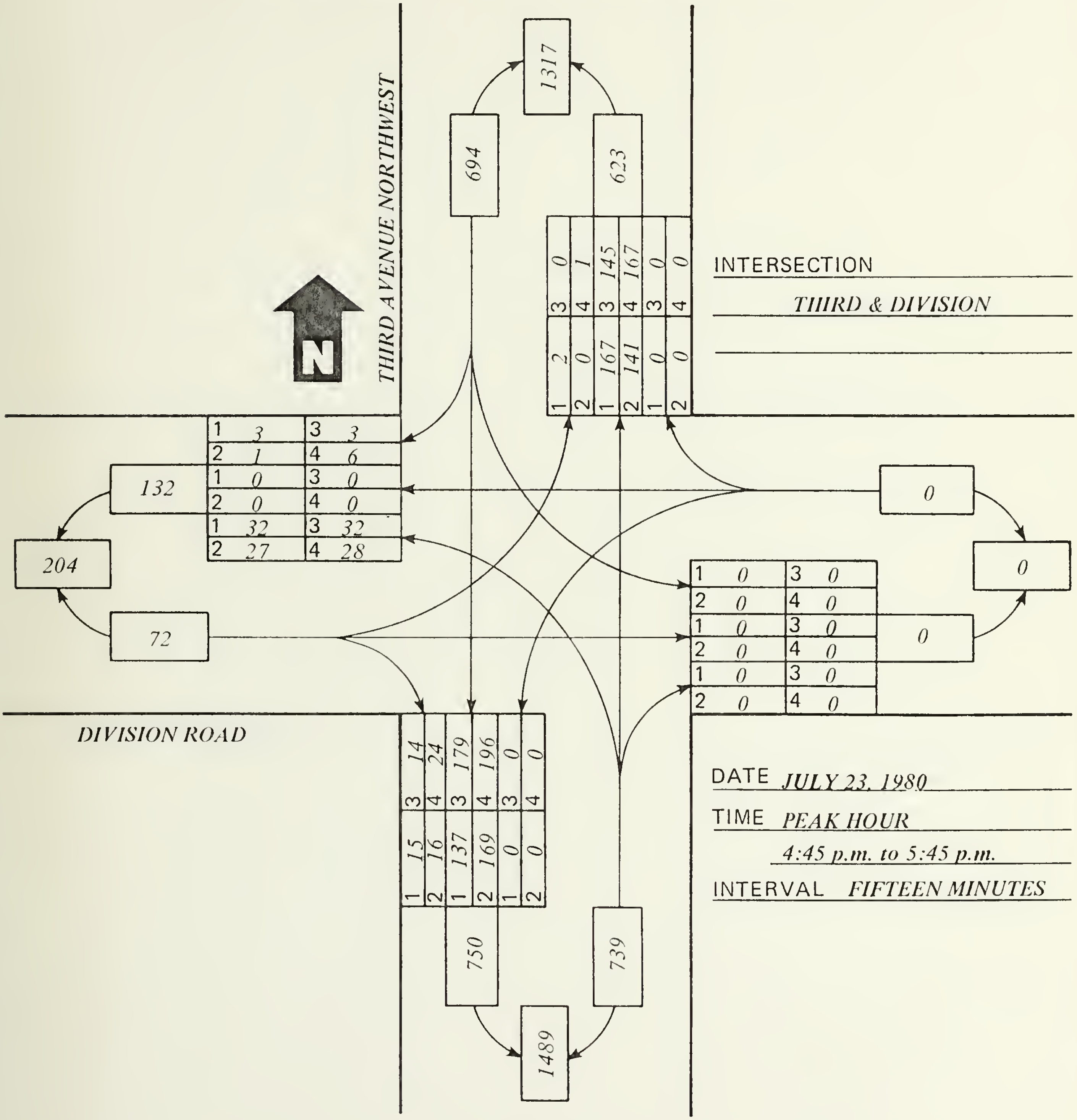
RPA Robert Peccia & Associates

TURNING MOVEMENTS



Robert Peccia & Associates

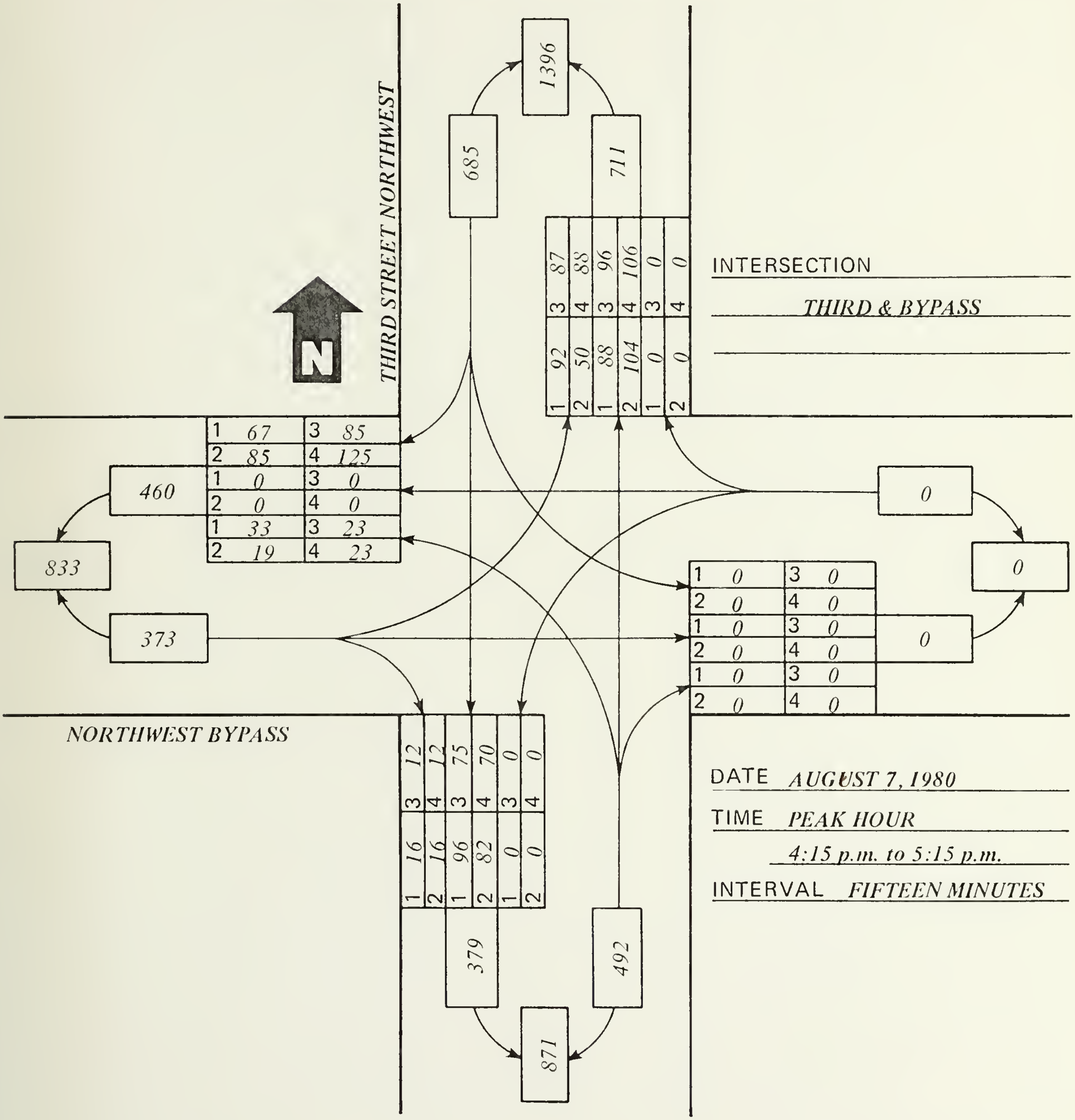
TURNING MOVEMENTS



INTERSECTION
THIRD & DIVISION

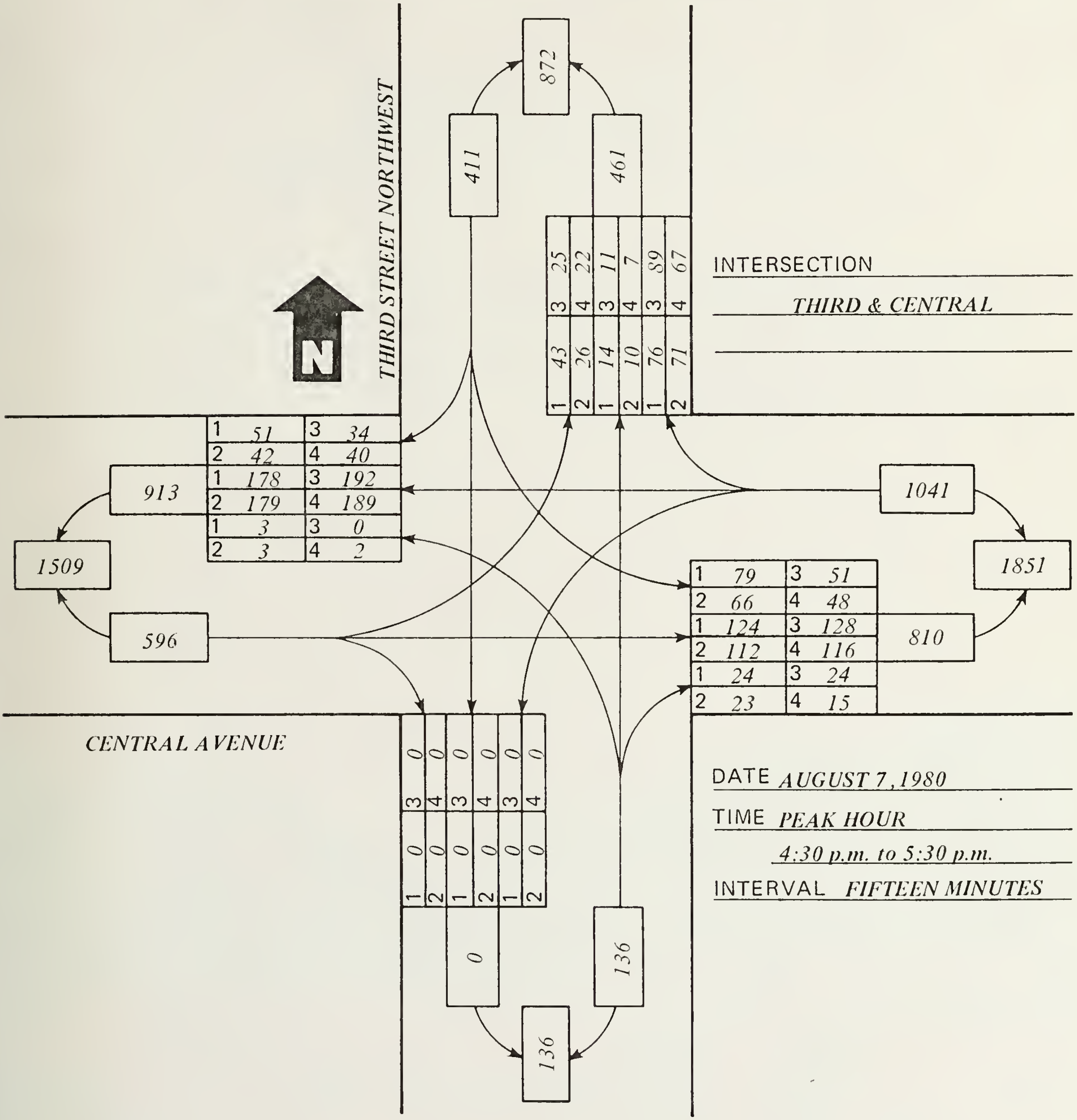
DATE *JULY 23, 1980*
TIME *PEAK HOUR*
4:45 p.m. to 5:45 p.m.
INTERVAL *FIFTEEN MINUTES*

TURNING MOVEMENTS



RPA Robert Peccia & Associates

TURNING MOVEMENTS



INTERSECTION
THIRD & CENTRAL

DATE *AUGUST 7, 1980*
TIME *PEAK HOUR*
4:30 p.m. to 5:30 p.m.
INTERVAL *FIFTEEN MINUTES*

APPENDIX B
Travel Time and Delay Data Summary

The test car technique was used to measure speeds and delays along the corridor. Thirty-two trips were made through the route, ten trips in each direction during two peak periods and six in each direction during off-peak periods. All of the trip data was compiled and the average speeds and delays are presented in this appendix. The data has been divided into peak and off-peak periods according to direction.

TRAVEL TIME AND DELAY STUDY
AVERAGE SPLIT SPEEDS
(Peak Periods)

Date: October 9, 1980 Weather: Clear Route: Third Street Northwest

Direction: Northeast Trip Started At: Third & Central Trip Ended At: Tenth & Smelter

Location (To - From)	Distance (ft.)	Average Delay (sec.)	Average Split Travel Speed (mph)	Average Split Running Speed (mph)
Central Avenue to Northwest Bypass	3,400	7.2	32.2	35.6
Northwest Bypass to Division Road	1,575	0	36.8	36.8
Division Road to Seventeenth Street	990	0	35.5	35.5
Seventeenth Street to Fourth Street	495	0	37.8	37.8
Fourth Street to Third & Smelter	690	1.6	31.9	35.1
Third & Smelter to Tenth & Smelter	3,325	6.4	33.5	35.9
	10,475			

Trip Length: 10,475 ft. Avg. Trip Time: 3 min. 38 sec. Avg. Trip Speed: 32.8 mph

Avg. Running Time: 3 min. 22 sec. Avg. Running Speed: 35.3 mph

Avg. Stopped Time: 15.2 sec. Number of Trips Run: Ten

TRAVEL TIME AND DELAY STUDY

AVERAGE SPLIT SPEEDS

(Off-Peak Periods)

Date: October 9, 1980 Weather: Clear Route: Third Street Northwest

Direction: Northeast Trip Started At: Third & Central Trip Ended At: Tenth & Smelter

Location (To - From)	Distance (ft.)	Average Delay (sec.)	Average Split Travel Speed (mph)	Average Split Running Speed (mph)
Central Avenue to Northwest Bypass	3,400	3.5	32.1	33.4
Northwest Bypass to Division Road	1,575	0	36.4	36.4
Division Road to Seventeenth Street	990	0	31.7	31.7
Seventeenth Street to Fourth Street	495	0	33.0	33.0
Fourth Street to Third & Smelter	690	0	31.9	31.9
Third & Smelter to Tenth & Smelter	3,325	20.5	28.7	34.3
	10,475			

Trip Length: 10,475 ft. Avg. Trip Time: 3 min. 47 sec. Avg. Trip Speed: 31.4 mph

Avg. Running Time: 3 min. 23 sec. Avg. Running Speed: 35.1 mph

Avg. Stopped Time: 24 sec. Number of Trips Run: Six

TRAVEL TIME AND DELAY STUDY
AVERAGE SPLIT SPEEDS
(Peak Periods)

Date: October 9, 1980 Weather: Clear Route: Third Street Northwest

Direction: Southwest Trip Started At: Tenth & Smelter Trip Ended At: Third & Central

Location (To - From)	Distance (ft.)	Average Delay (sec.)	Average Split Travel Speed (mph)	Average Split Running Speed (mph)
Tenth & Smelter to Third & Smelter	3,325	4.8	28.5	30.4
Third & Smelter to Fourth Street	690	0	33.2	33.2
Fourth Street to Seventeenth Street	495	0	35.7	35.7
Seventeenth Street to Division Road	990	0	35.8	35.8
Division Road to Northwest Bypass	1,575	3.5	31.5	34.6
Northwest Bypass to Central Avenue	3,400	24.7	26.0	34.0
	10,475			

Trip Length: 10,475 ft. Avg. Trip Time: 4 min. 4 sec. Avg. Trip Speed: 29.2 mph

Avg. Running Time: 3 min. 31 sec. Avg. Running Speed: 33.8 mph

Avg. Stopped Time: 33 sec. Number of Trips Run: Ten

TRAVEL TIME AND DELAY STUDY
AVERAGE SPLIT SPEEDS
(Off-Peak Periods)

Date: October 9, 1980 — Weather: Clear — Route: Third Street Northwest

Direction: Southwest — Trip Started At: Tenth & Smelter — Trip Ended At: Third & Central

Location (To - From)	Distance (ft.)	Average Delay (sec.)	Average Split Travel Speed (mph)	Average Split Running Speed (mph)
Tenth & Smelter to Third & Smelter	3,325	3.7	32.2	33.6
Third & Smelter to Fourth Street	690	0	33.0	33.0
Fourth Street to Seventeenth Street	495	0	34.0	34.0
Seventeenth Street to Division Road	990	0	37.2	37.2
Division Road to Northwest Bypass	1,575	16.0	23.5	34.9
Northwest Bypass to Central Avenue	3,400	22.7	24.9	31.7
	10,475			

Trip Length: 10,475 ft. — Avg. Trip Time: 4 min. 18 sec. — Avg. Trip Speed: 27.6 mph

Avg. Running Time: 3 min. 36 sec. — Avg. Running Speed: 33.1 mph

Avg. Stopped Time: 42.4 sec. — Number of Trips Run: Six

APPENDIX C
Traffic Conflict Study Results

In July of 1980, three intersections were studied; Tenth and Smelter, Third and Fourth, and Third and Seventeenth. Each test location was observed during four hours of peak-volume traffic. All evasive movements, rapid lane changes, and braking to avoid collisions were identified as conflicts. All violations of traffic law were also identified. All data has been converted into a per hour rate. The study results have been categorized according to type of conflict or violation occuring on each approach to the test intersection.

TRAFFIC CONFLICT STUDY SUMMARY

INTERSECTION: TENTH & SMELTER	INTERSECTION APPROACH			
	North	South	East	West
Average Approach Volume Per Hour	889	2,558	616	2,507
CONFLICTS (Avg. Number Per Hour)				
Left Turn - Too Fast	0	0.25	0	0
Right Turn - Too Fast	0	0	0	13.50
Rear End - Right Turn - Slow Vehicle	0.75	0	0.25	49.00
Rear End - Pedestrian - Southbound/South Leg	0	2.00	0	0
Rear End - Slow Vehicle - Left Turn	0	2.75	0	0
U Turn	0	0	0	0.25
Sideswipe - Left Turn	0	14.00	0	0
Rear End - Slow Vehicle	0	0	0	0.50
VIOLATIONS (Avg. Number Per Hour)				
Left Turn - Wrong Lane	0	28.25	16.75	25.50
Right Turn - Wrong Lane	8.50	0	1.25	0
Ran Light - Amber	1.00	0.25	0	0.25
Ran Light - Red	1.25	0	0	0
Failed to Stop - Right Turn	10.00	5.50	1.75	0

TRAFFIC CONFLICT STUDY SUMMARY

INTERSECTION: THIRD & FOURTH	INTERSECTION APPROACH			
	North	South	East	West
Average Approach Volume Per Hour	357	333	1,874	1,969
CONFLICTS (Avg. Number Per Hour)				
Rear End - Right Turn/Off	0	0	1.00	3.00
Rear End - Right Turn/On	0	0	0.75	0.50
Rear End - Left Turn/On	.25	0	1.50	0.50
Rear End - Slow Vehicle	0	0	0.25	0.50
Rear End - Pedestrian	0	0	1.50	0
Rear End - U Turn	0	0	0.25	0
Broadside Cross Traffic	.75	.50	1.25	1.50
Head On	1.25	1.00	0	0
U Turn	0	0	4.00	8.00
Entered West Gate through Exxon	0	0	0	63.50
VIOLATIONS (Avg. Number Per Hour)				
Failed to Stop	10.25	0	0	0
Left Turn - Wrong Lane	1.00	23.00	0	0
Right Turn - Wrong Lane	9.50	1.00	0.25	0
Driving Down Wrong Side of Median	0	0	0	0.75

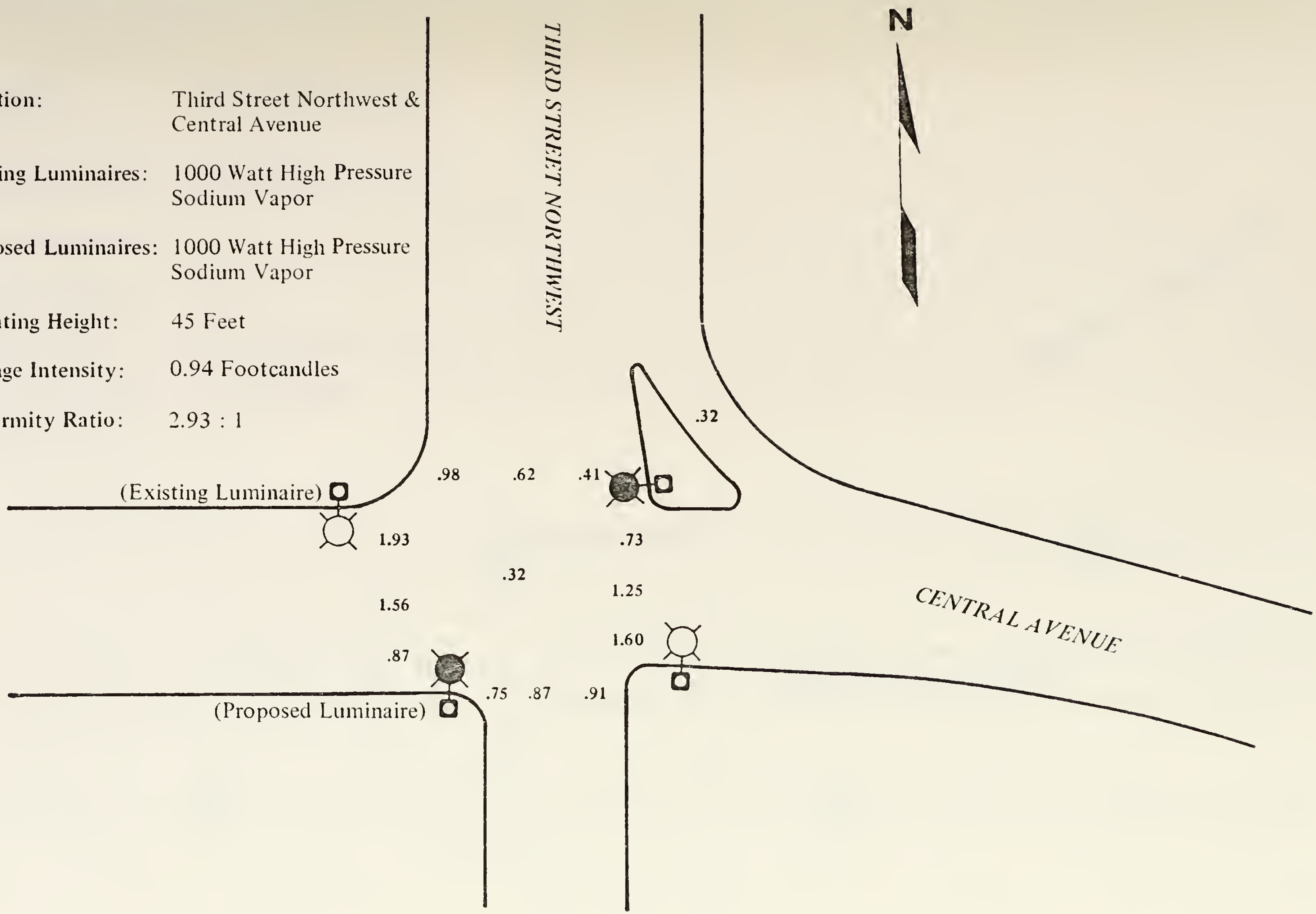
TRAFFIC CONFLICT STUDY SUMMARY

INTERSECTION: THIRD & SEVENTEENTH	INTERSECTION APPROACH			
	North	South	East	West
Average Approach Volume Per Hour	411	469	42	57
CONFLICTS (Avg. Number Per Hour)				
Rear End - Left Turn/On	0.50	1.75	0.25	0
Rear End - Right Turn/Off	3.25	0.75	0	0
Rear End - Left Turn/Off	0.50	1.00	0	0
Rear End - Right Turn/On	4.00	0.50	0	0
Broadside - Cross Traffic	0.75	0.25	0	0
Rear End - Slow Vehicle	2.00	0.25	0	0
U Turn	2.50	0.50	0	0
VIOLATIONS (Avg. Number Per Hour)				
Left Turn - Driving Down Wrong Side Of Median	0.50	5.75	0	0
Failed to Stop	0	0	4.50	1.00
Left Turn - Wrong Lane	0	0	2.00	4.50
Right Turn - Wrong Lane	0	0	4.00	4.75

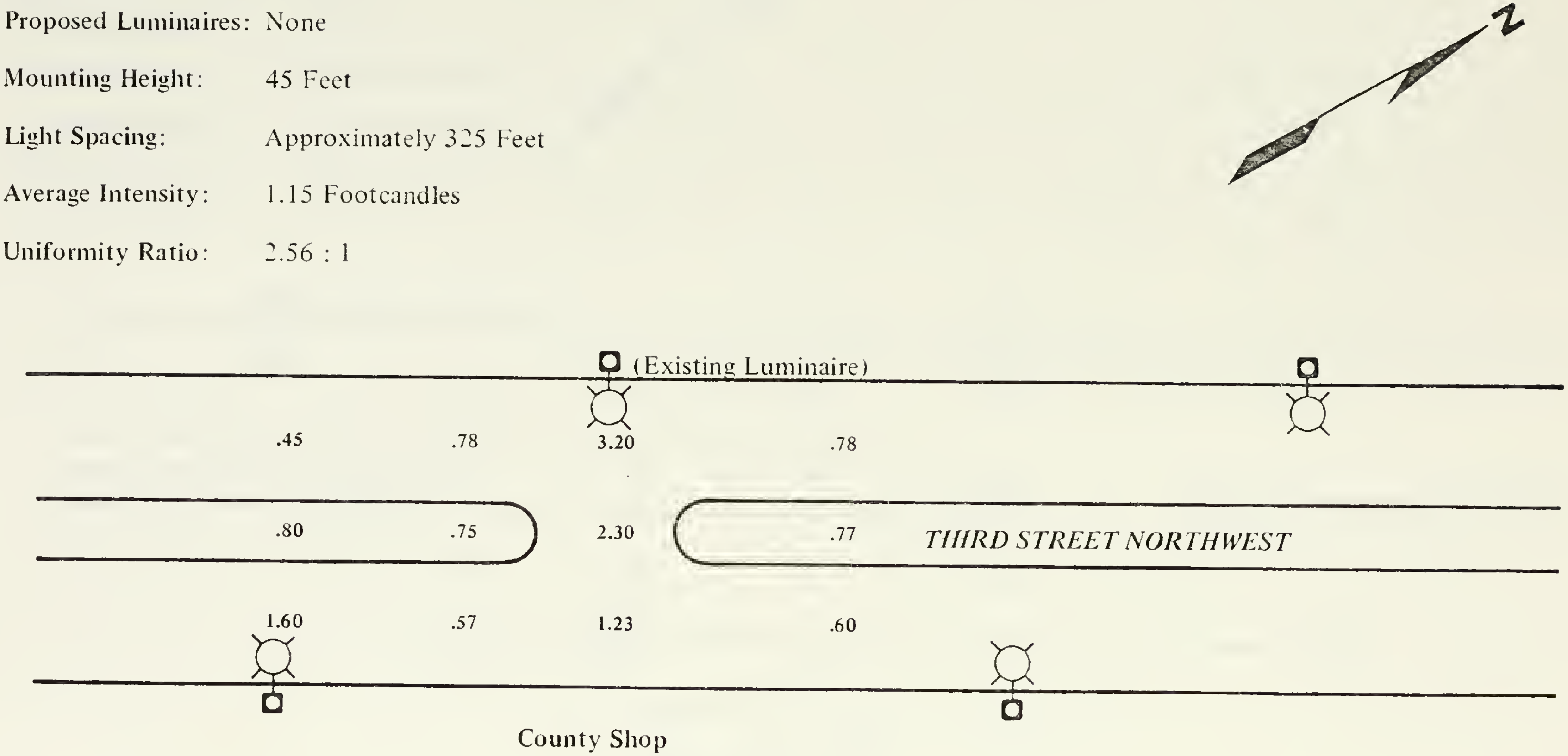
APPENDIX D
Roadway Light Test Summary

In July of 1980, light meter readings were taken at seven locations along the corridor. This appendix contains the existing lighting layout, the light meter intensity readings and the corresponding test pattern, and proposed luminaire locations for each area tested.

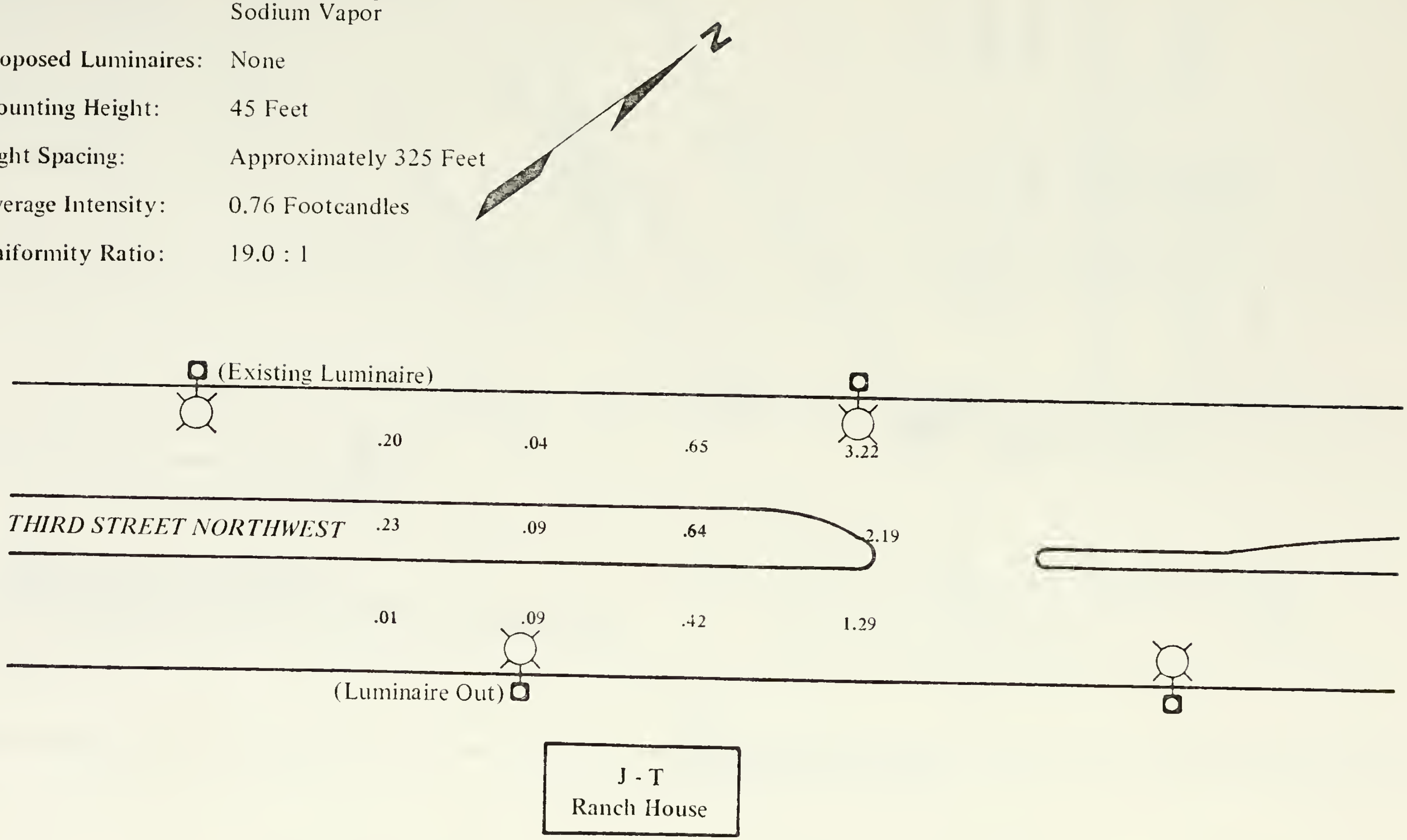
Location:	Third Street Northwest & Central Avenue
Existing Luminaires:	1000 Watt High Pressure Sodium Vapor
Proposed Luminaires:	1000 Watt High Pressure Sodium Vapor
Mounting Height:	45 Feet
Average Intensity:	0.94 Footcandles
Uniformity Ratio:	2.93 : 1



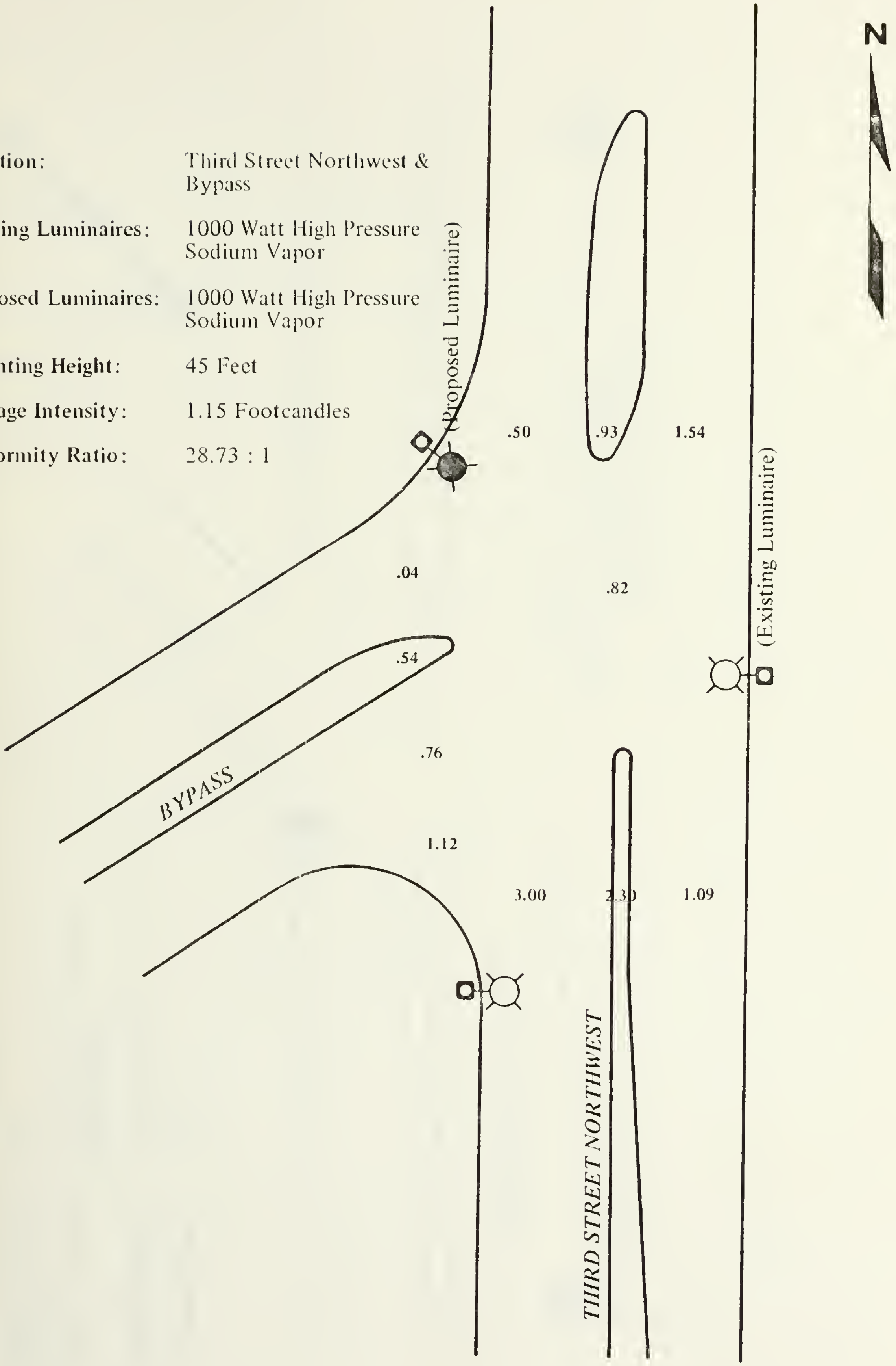
Location:	Third Street Northwest north of Third Avenue
Existing Luminaires:	1000 Watt High Pressure Sodium Vapor
Proposed Luminaires:	None
Mounting Height:	45 Feet
Light Spacing:	Approximately 325 Feet
Average Intensity:	1.15 Footcandles
Uniformity Ratio:	2.56 : 1



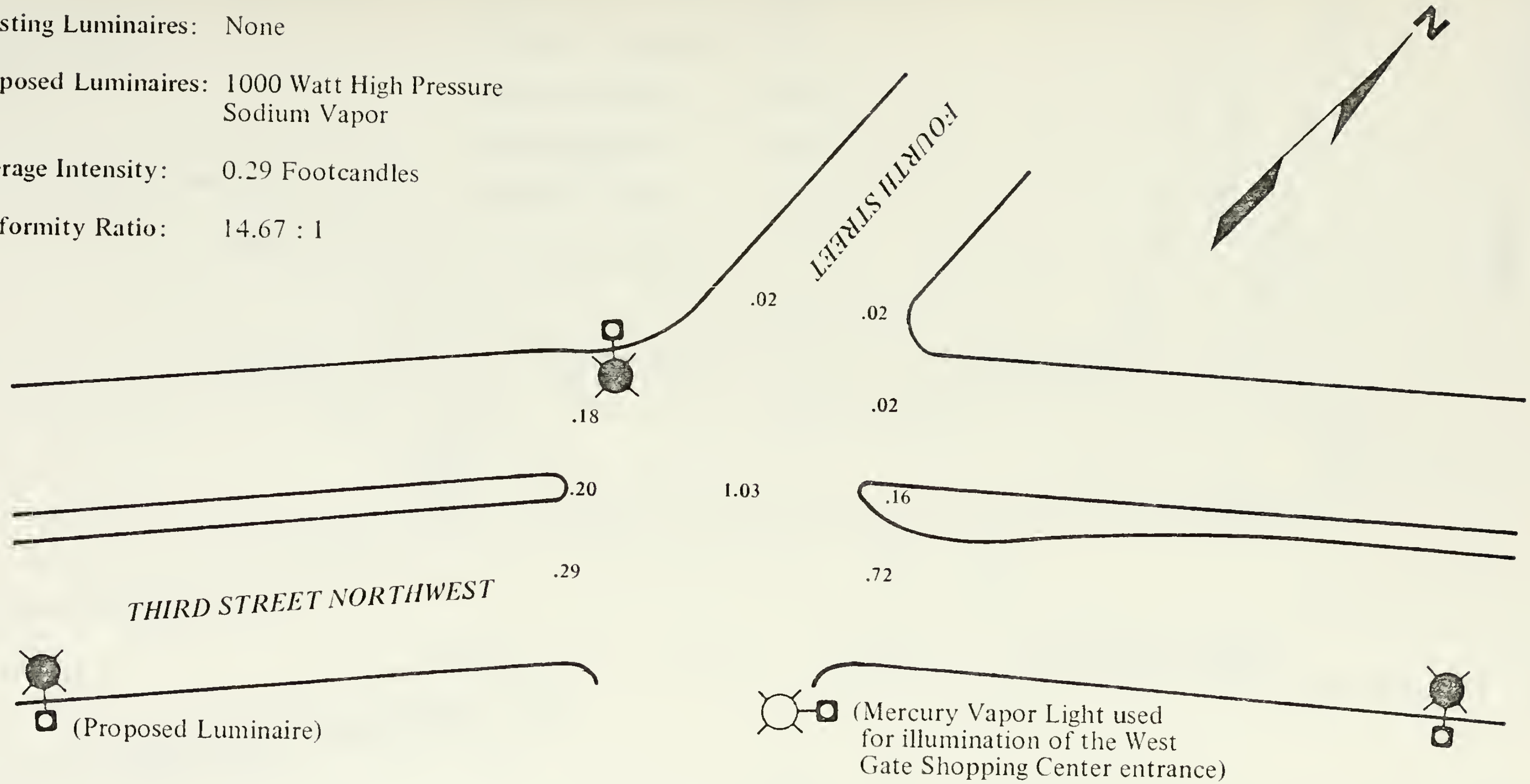
Location:	J - T Ranch House
Existing Luminaires:	1000 Watt High Pressure Sodium Vapor
Proposed Luminaires:	None
Mounting Height:	45 Feet
Light Spacing:	Approximately 325 Feet
Average Intensity:	0.76 Footcandles
Uniformity Ratio:	19.0 : 1



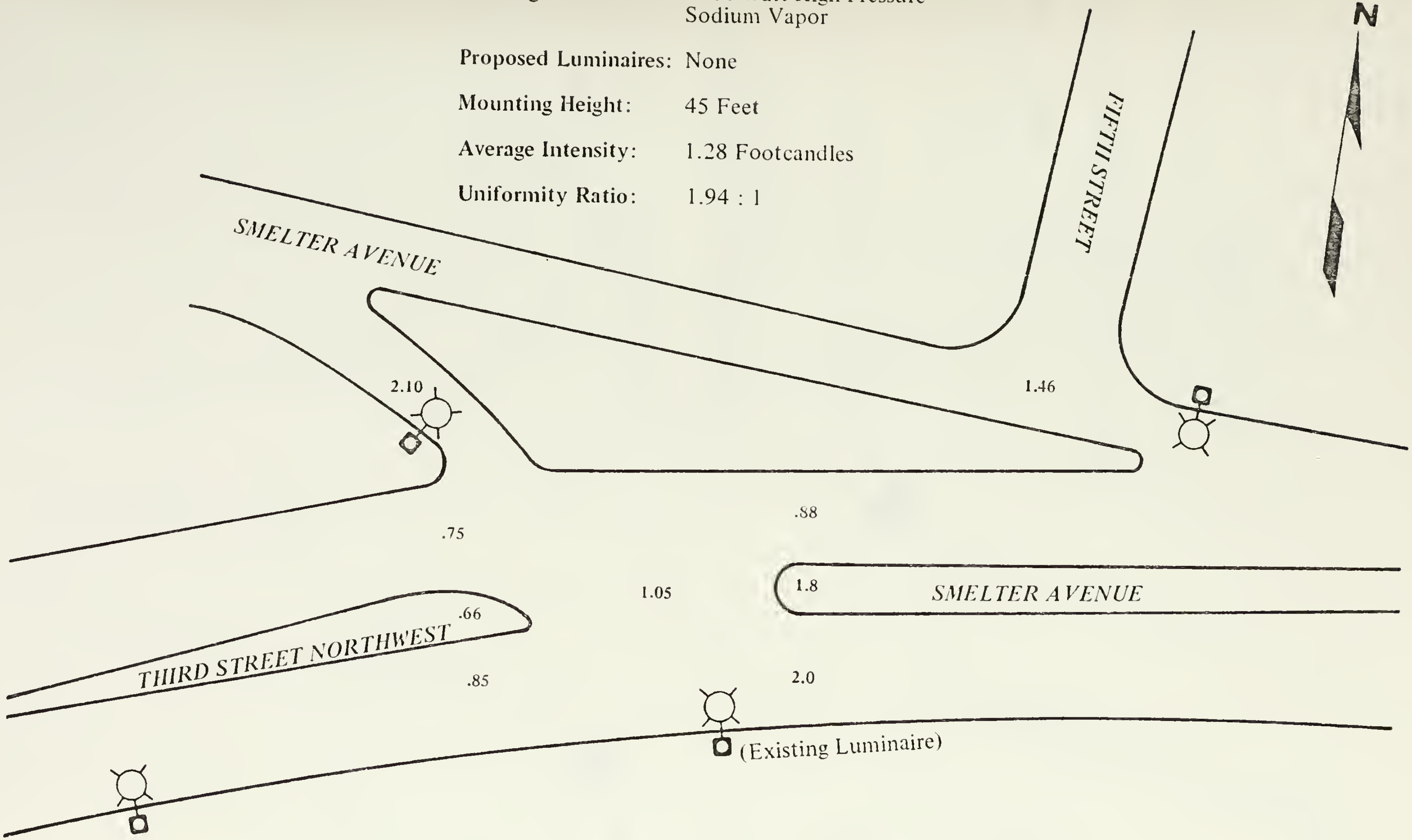
Location:	Third Street Northwest & Bypass
Existing Luminaires:	1000 Watt High Pressure Sodium Vapor
Proposed Luminaires:	1000 Watt High Pressure Sodium Vapor
Mounting Height:	45 Feet
Average Intensity:	1.15 Footcandles
Uniformity Ratio:	28.73 : 1



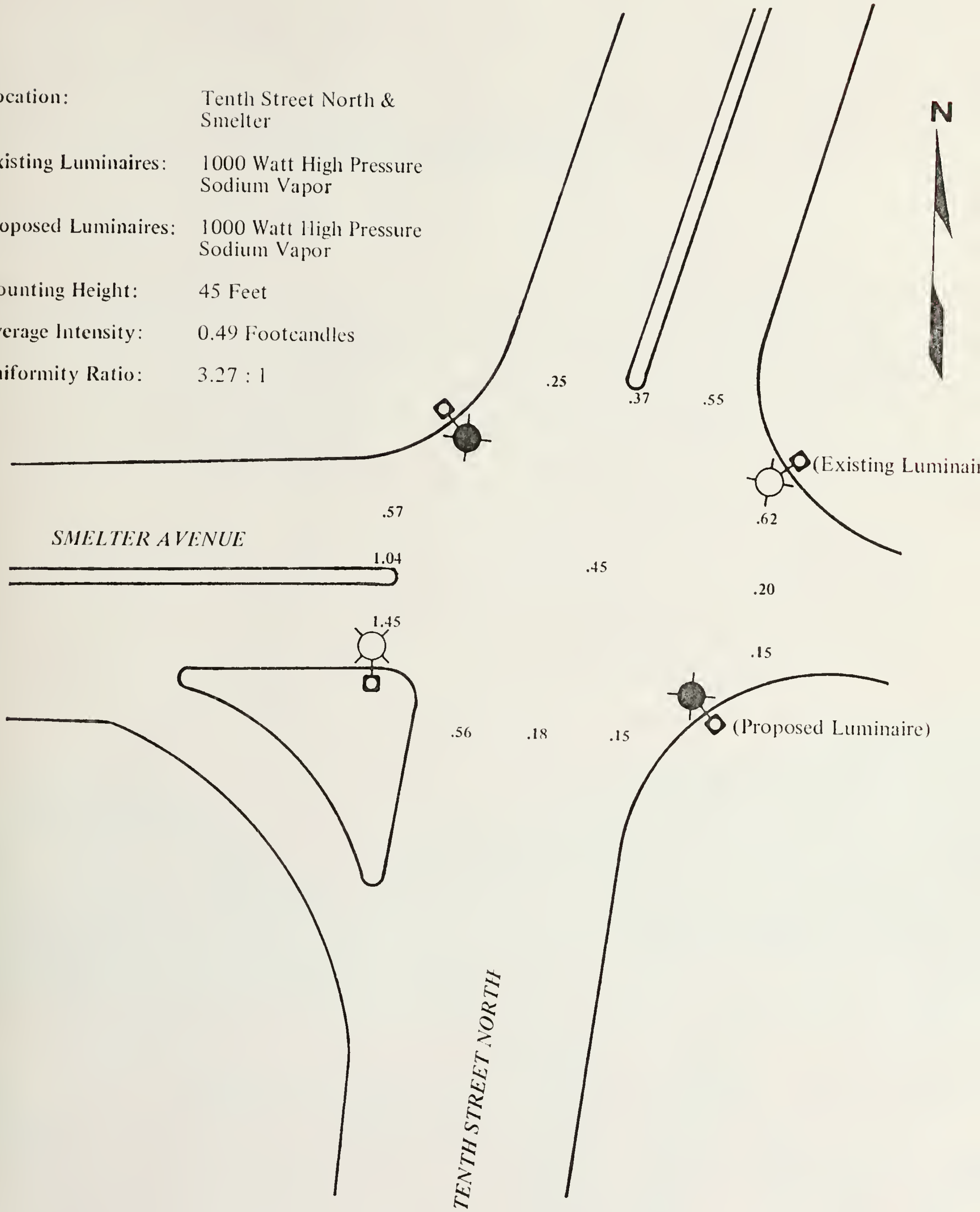
Location:	Third Street Northwest & Fourth Street
Existing Luminaires:	None
Proposed Luminaires:	1000 Watt High Pressure Sodium Vapor
Average Intensity:	0.29 Footcandles
Uniformity Ratio:	14.67 : 1



Location:	Third Street Northwest & Smelter Avenue
Existing Luminaires:	1000 Watt High Pressure Sodium Vapor
Proposed Luminaires:	None
Mounting Height:	45 Feet
Average Intensity:	1.28 Footcandles
Uniformity Ratio:	1.94 : 1



Location:	Tenth Street North & Smelter
Existing Luminaires:	1000 Watt High Pressure Sodium Vapor
Proposed Luminaires:	1000 Watt High Pressure Sodium Vapor
Mounting Height:	45 Feet
Average Intensity:	0.49 Footcandles
Uniformity Ratio:	3.27 : 1



APPENDIX E
Cost Estimate Summary

A cost estimate for each recommended improvement mentioned in Chapter X is presented in this Appendix. The total cost of each improvement includes all major construction items, a ten percent contingency factor and a twenty percent engineering and administrative fee. The unit prices used were derived from recent state-wide bid tabulations provided by the Department of Highways. All cost estimates are in 1980 dollars.

IMPROVEMENT COSTS

I. UPGRADE INTERSECTION LIGHTING

Tenth & Central (two lights)	Quantity	Unit Price	Total Cost
New Light Standards	2	$1,500.00	$3,000.00
Luminaire Assembly (1000 W.S.V.)	2	360.00	720.00
1½-inch Rigid Steel Conduit	250 LF	4.10	1,025.00
600 V. Copper Conductor Cable	500 LF	.60	300.00
Class D Concrete	1.4 yd.	575.00	805.00
Construction Costs			$5,850.00
Contingencies (10%)			585.00
Engineering (20%)			1,170.00
Subtotal:			$7,605.00

Third & Bypass (one light)	Quantity	Unit Price	Total Cost
New Light Standard	1	$1,500.00	$1,500.00
Luminaire Assembly (1000 W.S.V.)	1	360.00	360.00
1½-inch Rigid Steel Conduit	125 LF	4.10	513.00
600 V. Copper Conductor Cable	250 LF	.60	150.00
Class D Concrete	.7 yd.	575.00	403.00
Construction Costs			$2,926.00
Contingencies (10%)			293.00
Engineering (20%)			585.00
Subtotal:			$3,804.00

Sixth & Smelter and Eighth & Smelter (two lights)	Quantity	Unit Price	Total Cost
New Light Standard	2	$1,500.00	$3,000.00
Luminaire Assembly (1000 W.S.V.)	2	360.00	720.00
1½-inch Rigid Steel Conduit	150 LF	4.10	615.00
600 V. Copper Conductor Cable	500 LF	.60	300.00
Class D Concrete	1.4 yd.	575.00	805.00
Photoelectric Control	2	100.00	200.00
Service & Control Assembly	2	525.00	1,050.00
Construction Costs			$6,690.00
Contingencies (10%)			669.00
Engineering (20%)			1,338.00
Subtotal:			$8,697.00

Tenth & Smelter (two lights)	Quantity	Unit Price	Total Cost
New Light Standards	2	$1,500.00	$3,000.00
Luminaire Assembly (1000 W.S.V.)	2	360.00	720.00
1½-inch Rigid Steel Conduit	275 LF	4.10	1,128.00
600 V. Copper Conductor Cable	550 LF	.60	330.00
Class D Concrete	1.4 yd.	575.00	805.00
Construction Costs			$5,983.00
Contingencies (10%)			598.00
Engineering (20%)			1,197.00
Subtotal:			$7,778.00

TOTAL COST TO UPGRADE INTERSECTION LIGHTING: $27,884.00

2. INSTALL NEW ROADWAY LIGHTING SYSTEM (20 Lights)

	Quantity	Unit Price	Total Cost
New Light Standards	20	$1,500.00	$30,000.00
Luminaire Assembly (1000 W.S.V.)	20	360.00	7,200.00
1½-inch Rigid Steel Conduit	6525 LF	4.10	26,753.00
600 V. Copper Conductor Cable	13,050 LF	.60	7,830.00
Class D Concrete	14 yd.	575.00	8,050.00
Photoelectric Control	2	100.00	200.00
Service & Control Assembly	2	525.00	1,050.00
Construction Costs			$81,083.00
Contingencies (10%)			8,108.00
Engineering (20%)			16,217.00

TOTAL COST TO INSTALL NEW ROADWAY LIGHTING SYSTEM: $105,408.00

3. INSTALL ADDITIONAL LOOP DETECTORS AND RESTRIPE LANES AT TENTH & SMELTER

	Quantity	Unit Price	Total Cost
Loop Detectors	LS	$5,500.00	$5,500.00
Plastic Markings	294 SF	4.50	1,323.00
Painting	4 gal.	50.00	200.00
Construction Costs			$7,023.00
Contingencies (10%)			702.00
Engineering (20%)			1,405.00

TOTAL COST TO INSTALL LOOP DETECTORS AND RESTRIPE LANES: $9,130.00

4. REMOVE EXCESS DRIVEWAY CURB CUTS (21)

	Quantity	Unit Price	Total Cost
Remove Curb Cuts (35 ft. ea.)	735 LF	$6.00	$4,410.00
New Curb & Gutter	735 LF	7.00	5,145.00
Construction Costs			$9,555.00
Contingencies (10%)			956.00
Engineering (20%)			1,911.00
TOTAL COST TO REMOVE EXCESS DRIVEWAY CURB CUTS:			$12,422.00

5. MOVE PEDESTRIAN FACILITIES AT THIRD & BYPASS

	Quantity	Unit Price	Total Cost
Move Signal Heads	LS	$1,500.00	$1,500.00
Plastic Markings	212.5 SF	4.50	956.00
Construction Costs			$2,456.00
Contingencies (10%)			246.00
Engineering (20%)			491.00
TOTAL COST TO MOVE PEDESTRIAN FACILITIES:			$3,193.00

6. ALTER MEDIAN AT THIRD & BYPASS

	Quantity	Unit Price	Total Cost
Remove Median Curb	100 LF	$3.50	$350.00
New Median Curb	300 LF	5.00	1,500.00
Plant Mix Asphalt	25 T	40.00	1,000.00
Construction Costs			$2,850.00
Contingencies (10%)			285.00
Engineering (20%)			570.00
TOTAL COST TO ALTER MEDIAN AT THIRD & BYPASS:			$3,705.00

7. SIGN NO PARKING AREAS

	Quantity	Unit Price	Total Cost
Signposts In Place (69)	2227 lb.	$2.00	$4,454.00
No Parking Signs	103.5 sf	14.00	1,449.00
Curbs Painted	117 gal.	32.00	3,744.00
Construction Costs			$9,647.00
Contingencies (10%)			965.00
Engineering (20%)			1,929.00
TOTAL COST TO SIGN NO PARKING AREAS:			**$12,541.00**

8. IMPROVE WESTGATE ENTRANCES

	Quantity	Unit Price	Total Cost
Remove Curb & Gutter	150 LF	$6.00	$900.00
New Curb & Gutter	300 LF	7.00	2,100.00
Plant Mix	235 T	25.00	5,875.00
Painting	6 gal.	50.00	300.00
Signposts In Place	99 lb.	2.00	198.00
Stop Signs	19 sf	14.00	266.00
Construction Costs			$9,639.00
Contingencies (10%)			964.00
Engineering (20%)			1928.00
TOTAL COST TO IMPROVE WESTGATE ENTRANCES:			**$12,531.00**

9. ADD NEW SIDEWALK ON SOUTH SIDE, 17th TO 6th STREETS

	Quantity	Unit Price	Total Cost
Unclassified Excavation	172 CY	$5.00	$860.00
New Sidewalk	1028 SY	18.50	19,018.00
Construction Costs			$19,878.00
Contingencies (10%)			1,988.00
Engineering (20%)			3,976.00
TOTAL COST TO ADD NEW SIDEWALK:			$25,842.00

10. INSTALL NEW INTERSECTION LANE USE SIGNS

	Quantity	Unit Price	Total Cost
Signposts In Place (3)	99 lbs.	$2.00	$198.00
Lane Use Signs	158 SF	14.00	2,212.00
Overhead Sign Standards	6	2,000.00	12,000.00
Class D Concrete	4.5 yd.	575.00	2,588.00
Construction Costs			$16,998.00
Contingencies (10%)			1,700.00
Engineering (20%)			3,400.00
TOTAL COST TO INSTALL NEW INTERSECTION LANE USE SIGNS:			$22,098.00

11. SIGN & MARK CROSSWALKS AT 4th & 6th STREETS AND REMOVE PEDESTRIAN SIGNAL AT 3rd & SMELTER

	Quantity	Unit Price	Total Cost
Plastic Markings	1232 SF	$4.50	$5,544.00
Signposts In Place (8)	264 lb.	2.00	528.00
Crosswalk Signs	50 sf	14.00	700.00
Remove Signal & Pushbutton Control	LS	250.00	250.00
Construction Costs			$7,022.00
Contingencies (10%)			702.00
Engineering (20%)			1,404.00
TOTAL COST TO SIGN & MARK CROSSWALKS:			$9,128.00

12. PIN DOWN CURBS AT J - T

	Quantity	Unit Price	Total Cost
Pin Down Curbing	400 LF	$8.00	$3,200.00
Contingencies (10%)			320.00
Engineering (20%)			640.00
TOTAL COST TO PIN DOWN CURBS AT J - T:			$4,160.00